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The Lubricating Power of Oils on Wool Fibers*

By JOHN H. SKINKLE, S.B.**
Assisted by ROLAND C. MORRISON, B.T.C.

THE use of oils on scoured wool preparatory to the mechanical processes is in general use in the industry for the purpose of reducing the clinging power of the fibers for each other to the point where impurities and short fibers may be removed easily from the longer fibers. Most of the data on the use of oils for wool fiber lubrication is concerned with the ease of removal of the oil and the tendency of the oil to become rancid, and little or no work has been done on the effects of the oils on the lubrication of the fibers. It is generally supposed that olive oil is superior to other oils for this purpose, but that mineral oil would be satisfactory provided that it could be easily removed afterward; therefore the first work was done in the form of a comparison of olive oil and mineral oil.

For mechanical reasons, the measurement of the coefficient of friction of fiber on fiber was impracticable so it was decided to measure the coefficient of friction of fibers on glass, glass being selected as being most easily reproducible. The apparatus used was a modification of that described by Mercier† and used by him to measure the coefficient of friction of fabrics. A simple relationship exists between the angle of slide of a material and its coefficient of friction.

Let μ = coefficient of friction
Let F = frictional resistance acting on a block
Let N = force normal to the surface
Let W = weight of the block
Let A = angle of the inclined plane

If we assume that a block is resting on an inclined plane so that it is just on the point of starting to slide, then the frictional resistance of the block is just equal to a moment of the gravitational force parallel to the surface of the plane and

$$F = W \sin A$$

The force normal to the surface of the plan is

$$N = W \cos A$$

By definition,

$$\mu = F/N$$

Therefore,

$$\mu = \frac{F}{N} = \frac{W \sin A}{W \cos A} = \tan A$$

The apparatus consists of a baseboard which may be leveled, and hinged to it at one end is a board with an inset piece of glass to serve as the inclined plane. The angle of the plane was varied by moving a block of steel machined to exactly two inches in height along guides lengthwise of the baseboard. The tangent of the angle (or coefficient of friction) was then obtained by dividing 2.000 inches by the distance from the point of swing to the base of the steel block. The fibers in the form of tops were held lengthwise of a wooden block and covering the bottom of the block.

The block and fibers were placed on the inclined plane and the angle increased to the point where, with the assistance of light tappings, the block commenced to slide. The angle was then lowered slightly and the process repeated. After each determination, the glass plate was cleaned off with a volatile solvent.

A sample of wool top large enough to give all the samples necessary was obtained from the Wool Department of the Lowell Textile Institute and extracted with gasoline until less than 0.1% oil was left. Fractions of this top were then soaked in solutions of the oils in petroleum ether of such strength as to give a series of values for each oil.

Preliminary work showed that check results could not be obtained from the first slide of the block, presumably because a thin film of oil was then deposited on the glass.

After the determination of the coefficient of friction of each sample of wool, the amount of oil present was determined by an extraction in the Soxhlet apparatus.

The oils used were of the following properties:

*A Bulletin of the Lowell Textile Institute.
** Instructor, Chemistry and Dyeing Dept., Lowell Textile Inst.
† American Wool and Cotton Reporter, November 13, 1930.

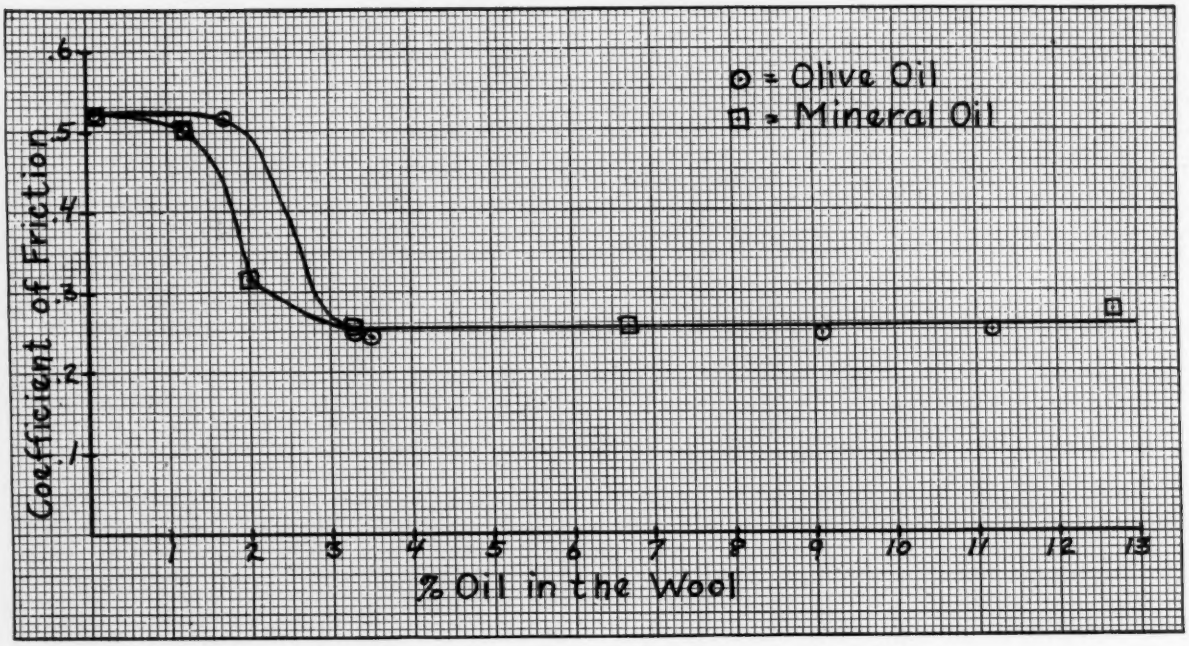

Figure 1

Olive Oil:

Specific gravity = 0.914 at 60° F.
Viscosity = 204 Saybolt seconds at 100° F.

Mineral Oil:

Specific gravity = 0.895 at 60° F.
Viscosity = 243 Saybolt seconds at 100° F.

The following data were obtained and plotted in the accompanying graph (Figure 1):

Olive Oil		*Mineral Oil*	
% Oil in Wool	Coefficient of Friction	% Oil in Wool	Coefficient of Friction
0.1	0.520	0.1	0.520
1.7	0.513	1.2	0.500
3.3	0.247	2.0	0.315
3.5	0.242	3.3	0.256
9.1	0.247	6.7	0.255
11.2	0.250	12.7	0.276

Conclusions

1. Practically identical results are obtained for both oils above three per cent.

2. Below a concentration of three per cent, mineral oil is superior to olive oil in lubricating efficiency.

3. There is no advantage, from the standpoint of lubrication, in adding more than 3-4% of either oil. This concentration is apparently enough to give a continuous coating to the fibers.

TECHNICAL NOTES FROM FOREIGN SOURCES

Green Azo-Pigments

German Patent No. 470,651 (24/I/'29)—*I. G. Farben-Ind. A.-G.*—The products covered by this procedure are formed by diazotizing a p-amino-acetophenone or benzophenone or a substitution-product of such ketones, and coupling to an anilide of acetacetic ester.

As the products are not sulfonic acids, it is not surprising that they are soluble in oils, etc.—they are valuable for such use, the more so because greens of this kind are uncommon.—Three examples are given.

Mono-Azo Dyestuffs (Pyrazolone Series, Chrome)

German Patent No. 477,451 (7/VI/'29)—*I. G. Farben-Ind. A.-G.*—The products covered by this patent are obtained by diazotizing either 2-amino-5-nitrophenol or 2-amino-4-chlor-5-nitrophenol, and coupling to a rather complex second component of the pyrazolone series; in which C_3 is substituted by a $—CH_2COOH$ or a —COO-alkyl group, and N_1 by a benzene ring substituted in the 2′ position by hydroxyl, in the 3′ position by a carboxyl, and in the 5′ position by a sulfonic acid group.

The products dye wool in various tones from yellowish to brownish red, which on after-chroming pass to bluish red or bordeaux red, very fast to fulling, potting, and light. One example is given.

(Continued on page 56)

PROCEEDINGS OF THE

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JANUARY 28, 1935

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(Continued on page (44) 52)

Proceedings of the American Association of Textile Chemists and Colorists

Commercial

Extraction of Bromine

From Sea Water*

By LEROY C. STEWART†

IN discussing the use of sea water as a raw material from which to obtain something valuable, popular interest seems to focus most on the possibilities of extracting gold. So I will preface the real meat of the matter with a few remarks on gold.

Literature references vary as to the amount of gold in sea water. Values have been reported ranging anywhere from 300 parts per billion to less than a tenth of a part per billion. Some very careful work done in our laboratories at Midland has indicated that sea water along the southeastern coast of this country contains in the neighborhood of 2 and a third parts of gold per billion. On this basis one cubic mile of sea water would contain about $6,000,000 worth of gold or if we figure it under the New Deal it would be about $10,000,000 worth.

However, one cubic mile of sea water contains $126,000,000 worth of bromine. You can see that it is a better manufacturing bet to go after the bromine and pass up the gold.

Actually, we did try to get some gold down there. From 12 tons of sea water we obtained a very fine, small particle. Frankly, it was a small flashback and by analysis it showed 50 percent gold and 50 percent silver. Some day it may be feasible to get gold from the sea water but just now our gold lies in the bromine which we can get from it.

This brings up the question as to what is the market for bromine. In 1924 the production of free and chemically combined bromine in this country amounted to approximately 2 million pounds. In 1931 this quantity had risen to about 9 million pounds, all of which was being produced from natural brines and from bitterns resulting from evaporation of sea water. This remarkable increase in consumption of bromine was due largely to the use of ethylene dibromide in conjunction with tetraethyllead in the treatment of gasoline motor fuel.

A number of years ago it became evident that the demand for bromine was becoming so great that its ordinary sources were inadequate and that new ones would have to be employed. It was logical that sea water should be considered for this purpose, in spite of the fact that its bromine content is less than 70 parts per million, since the enormous quantities of it which are available would insure an inexhaustible source of raw material. It was up to the chemist and engineer, however, to develop a practical and economical method of extracting this desirable halogen element.

The Ethyl Gasoline Corporation was one of the pioneers along this line. In 1924 they operated a small-scale plant with sea water as its source of bromine and produced tribromoaniline which can be used with tetraethyllead in the treatment of gasoline. Some months later, the same organization operated the process on board a boat, the S. S. Ethyl[4]. Their method involved the addition of aniline to chlorinated sea water to form tribromoaniline according to the reaction:

$$3NaBr + 3Cl_2 + C_6H_5NH_2 \longrightarrow C_6H_2Br_3NH_2 + 3NaCl + 3HCl$$

A number of years ago The Dow Chemical Company likewise undertook the problem of extracting bromine from sea water but proposed to obtain it in the pure, elemental state by a process somewhat similar to that in use on natural brines at their plant in Midland Beach. It was recognized that modifications and refinements would have to be made in the old procedure, but the basic principle was considered practical and economically sound. This process consists essentially of (*a*) oxidizing a natural bromide-containing brine with chlorine to liberate the bromine, (*b*) blowing the free bromine out of solution with air, and (*c*) absorbing the bromine from the air with an alkali carbonate solution from which it subsequently can be recovered in a commercially desirable form.

Through many years of experience and effort, the Dow process has been developed to the point where it is possible to recover, consistently, 95 per cent of the bromine content of the natural brines. The latter contain approximately 25 per cent total solids, consisting chiefly of the chlorides of sodium, calcium, and magnesium, together with approximately 1300 p. p. m. bromine. Sea water, however, contains about 3.5 per cent total solids, and only 65 to 70 p. p. m. bromine. This is approximately the same

* Presented at Annual Meeting, December 7th.

† The Dow Chemical Company, Midland, Mich.

Plant for Extracting Bromine from Sea Water and Manufacturing it Into Ethylene Dibromide.

Note: All cuts used with this paper are through the courtesy of Industrial and Engineering Chemistry.

bromine content as that of the waste effluent from the commercial process just mentioned. Consequently, when laboratory work was started on the problem of removing bromine from sea water, it is not surprising that at first a low efficiency was obtained.

RESEARCH LABORATORY DEVELOPMENTS

It was realized that an addition of acid as well as chlorine would be necessary in order to obtain a satisfactory yield of bromine from sea water on account of its alkalinity, as indicated by its pH of 7.2. Otherwise, when the solution was chlorinated, neutralization would have been effected at the expense of the liberated bromine. At the same time there would have been a corresponding formation of oxidized bromine products from which bromine could not easily have been liberated again by chlorine.

However, it was found that even in carefully neutralized sea water, a satisfactory yield of bromine was not obtained. An explanation of this appeared to be that in the exceptionally dilute solution the liberated bromine hydrolyzed to form bromic and hydrobromic acids according to the equation.

$$3Br_2 + 3H_2O \longrightarrow HBrO_3 + 5HBr$$

This being the case, such reaction would have continued until a sufficient concentration of hydrogen ions was obtained to suppress the hydrolysis.

In the production of bromine from Michigan brines, some hydrolysis and reabsorption of the halogen, with the attendant formation of acid, had been encountered. Because of the comparatively smaller volume handled in the case of the natural brine, it was feasible to permit such acidification by hydrolysis to take place and still to make a satisfactory recovery of the bromine. However, in the case of the enormous quantity of liquid involved with sea water as the source of bromine, such acidification by hydrolysis would be uneconomical. Careful laboratory research, involving potentiometric titration of natural sea water, showed that reabsorption of free bromine by hydrolysis ceased if the hydrogen-ion concentration were increased to a pH of 3 to 4 by the addition of acid from an outside source. This indicated, therefore, that in order to liberate bromine in sea water completely and efficiently, it would be necessary first to add sufficient acid to give a pH of approximately 3.5. This would require the use of approximately 0.27 pound of 96 per cent sulfuric acid per ton of sea water. In operation of the tribromoaniline process, already mentioned, it had also been found that it was desirable to add acid to the raw sea water before adding the chlorine, but a greater proportion was employed.

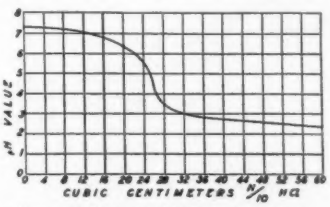

Fig. 1—Effect of Addition of Acid on pH of Sea Water

Figure 1 shows the variation in pH of raw sea water as affected by the addition of acid. Figure 2 shows the effect of variation of pH on the percentage of total bromine that can be liberated from the sea water by chlorine oxidation. Figure 3 indicates the effect of variation of pH of sea water on the chemical equivalents of chlorine required to liberate one equivalent of bromine. Figure 3 shows that, at a pH of 3.5 or less, the theoretical mole of chlorine was required per mole of bromine which was liberated.

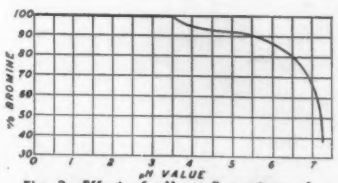

Fig. 2—Effect of pH on Percentage of Bromine Liberated in Sea Water

With the knowledge at hand of the definite proportion of acid which would have to be added to sea water in order to promote a highly efficient process, the next research problem which arose was that of developing a means of immediately and continuously indicating the progress of oxidation in the chlorination step, so that the

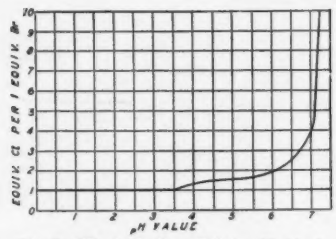

Fig. 3—Effect of pH on Chlorine Required to Liberate Bromine in Sea Water

degree of liberation of bromine could be ascertained at any time.

With the use of the ocean as a source of bromine, such enormous quantities of water were involved, that without some such control method, together with a method of continuously recording acidity, large losses of chlorine and acid would be sure to occur before the operator would realize what was happening. A method was finally developed which answered all requirements.

The new method of oxidation control depended on the fact that for every type of bromide-containing solution there is a characteristic range of oxidation potential values. This range depends on the initial concentration of bromine ions and also upon the collective effect of other ions present. It was found that, in acidified sea water, the first traces of free bromine in a solution that was being tested caused an immediate increase in oxidation potential. This rise was measured by the difference in voltage between a saturated calomel electrode and a platinum electrode. Figure 4 shows the relationship between the oxidation potential, expressed in volts, and the percentage of bromine liberated in sea water which contained about 3.5 per cent total solids in solution and about 60 to 70 p. p. m. bromine, and which had been acidified to a pH of 3 to 4. The characteristic potential under these conditions ranged between 0.88 and 0.97 volt. The methods of extracting bromine from sea water, involving the control of acidification and oxidation, are protected by patents[3].

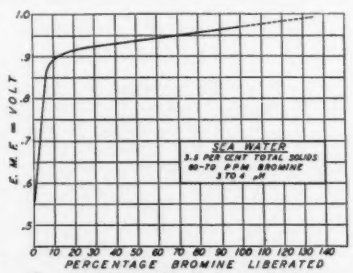

Fig. 4—Relationship Between Oxidation Potential and Percentage of Bromine Liberated in Sea Water

After obtaining a clear understanding of the factors which made for the most efficient liberation of bromine from sea water and development of satisfactory control methods, the laboratory and semiplant work on the process progressed much more rapidly. This work established the fact that air, blown countercurrent through a 70 p. p. m. bromine solution, would remove the halogen sufficiently to leave a concentration as low as 5 p. p. m. It was also found that soda ash solution would effectively remove the very low concentration of bromine from the air. In these experiments, performed at Midland, Mich., synthetic sea water was used at first, and this was followed by tests made on tank car shipments of true sea water. The chief result of the small-scale work was the demonstration that more than 50 per cent of the bromine in the real sea water could be extracted and actually collected as the pure liquid. The indicated cost of operating the process seemed satisfactorily low.

SELECTION OF PROCESS AND PLANT SITE

Considerable other research work was done before the final process was selected. Other natural waters, as well as sea water, were investigated as sources of bromine, and improved methods were devised for their use. More economical methods in conjunction with the liberation of bromine were studied, including the use of lime or metallic iron to remove bicarbonates from solution and thus to save acid. Many different processes for removing bromine from very dilute solutions were tried extensively in the laboratory, some on semiplant scale. These included precipitation[1], extraction, and vaporization of the bromine as well as its absorption and adsorption in various agents, particularly in charcoal[2]. While some showed fair success, the technic of blowing the bromine from solutions as dilute as the tailings from previous practice was improved and developed to a sound process as already described. Various methods were devised for recovering the bromine from the blowing-out air by both physical and chemical means, including immediate reaction of the bromine with ethylene. It is possible that some such improvements may be employed in the next few years. Finally, the commercial phases of correlating this industry with others were given careful study, and publication of the more interesting and important possibilities may be expected.

A comparison of the two general methods of obtaining bromine from sea water indicated that the direct extraction process possessed several economic advantages over the tribromoaniline method:

1. The direct process requires theoretically only 1 mole of chlorine for each mole of bromine which is liberated, whereas the other scheme requires 2 moles of chlorine per mole of bromine.

2. Smaller quantities of sulfuric acid are required by the direct process than by the other method.

3. Aniline is a relatively expensive raw material and is at a further economic disadvantage as a carrier of bromine for gasoline treatment when it is considered that tribromoaniline contains only 73 per cent bromine, whereas ethylene dibromide is 85 per cent bromine.

At this point in the history of the development it was decided to build and operate a pilot plant for extracting bromine from sea water by The Dow Chemical Company's process. The site for this unit was selected after considerable careful investigation, as it was proposed to build a commercial plant in the same location if the results of this venture were satisfactory. The chief requisites for such a site were:

1. The sea water at the point selected should not be diluted by fresh water streams.

2. The location should be such that it would be easy to get rid of the sea water from which the bromine had been extracted, without diluting the water entering the process.

3. There should be no appreciable quantities of industrial waste present in the water entering the process.

A thorough study was made of the eastern and southern coast lines of this country. In this connection information learned from U. S. Coast and Geodetic Survey, to the effect that the water of all streams entering the Atlantic Ocean flows southward, was of considerable assistance. Many samples of sea water were analyzed, and, except where dilution with fresh water was indicated by a study of the location from which the sample was taken, the bromine content was found to be 67 p. p. m. Before construction of the commercial plant, about twenty samples were taken during a boat trip from New Orleans to Havana and then to New York. The same bromine content of the deep sea water was found throughout the entire distance.

The various factors involved in the selection of the plant site all indicated that it should be located on the north shore of a river, close to the point where it entered the Atlantic Ocean, and that there should be no large river entering the ocean for a number of miles to the north of such a location. The long, narrow promontory of land in North Carolina at the mouth of the Cape Fear River, which separates the latter from the ocean, appeared to answer all the above requirements. Consequently, a large tract of land was acquired near the southern end of this peninsula, and in 1931 a pilot plant was constructed and operated to extract 500 pounds of bromine per day from sea water. The bromine was absorbed in soda ash solution to form a bromide-bromate liquor from which bromine could have been liberated by acidification. Operation of this small unit for 6 months

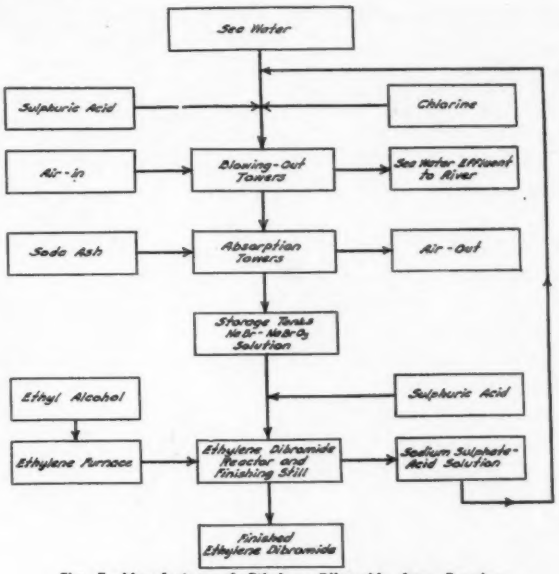

Fig. 5—Manufacture of Ethylene Dibromide from Bromine Extracted from Sea Water

furnished valuable experience which aided in the design of the commercial plant which was to follow.

CONSTRUCTION DATA ON COMMERCIAL PLANT

About the middle of July, 1933, the Ethyl-Dow Chemical Company was incorporated and the decision was made to construct a plant having a capacity to extract about 15,000 pounds of bromine per day from sea water and to manufacture it into somewhat more than 16,000 pounds of ethylene dibromide per day. Within a period of 5 months the plans were drawn, materials assembled, and the plant was built and put into operation. The design and construction was executed by The Dow Chemical Company organization with the exception of some of the common building operations which were let on contract. It is believed that this is an achievement in

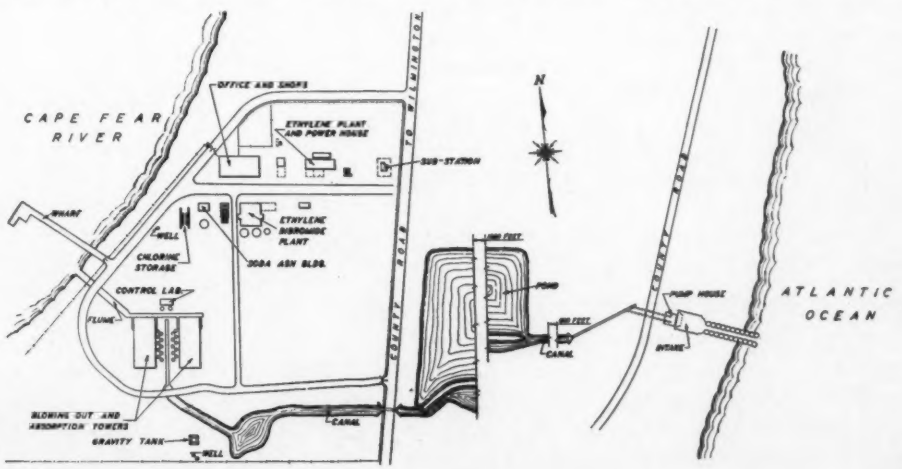

Fig. 6—Layout of Plant for Extracting Bromine from Sea Water and Manufacturing it Into Ethylene Dibromide

chemical engineering which is worthy of note, as the following facts relative to the construction of the plant will testify:

Clearing of ground started	July 27, 1933
Land cleared, acres	90
Ground broken for first building	Aug. 15, 1933
Production of ethylene dibromide commenced	Jan. 10, 1934
Wood piles driven (30 feet long)	1,800
Sheet steel piling (36-50 feet long), tons	750
Excavation, cubic yards	125,000
Dredging, cubic yards	100,000
Concrete, cubic yards	8,892
Reenforcing steel, tons	425
Structural steel, tons	350
Electric conduit, miles	9.5
Electric wiring, miles	38
Brick laid	3,540,764
Max. number men employed at one time, approx.	1,500
Approx. total of man-days	90,000
Building days	150
First working drawing completed	Aug. 14, 1933
Last working drawing completed	Nov. 2, 1933
No. of principal drawings (24 by 36 inches)	265

The construction facts become even more impressive when it is realized that the nearest railroad shipping point is at Wilmington, approximately 20 miles away. Consequently the large quantities of materials which were involved had to be trucked that distance to the construction site. In order that the work might proceed rapidly, a considerable number of engineers and superintendents were required. These were accommodated in a near-by fifty-room beach hotel which was leased and operated by the Ethyl-Dow Chemical Company.

Shortly before the construction work was completed, a wharf was built and a channel was dredged out to the navigable part of the Cape Fear River so that boat transportation could be used for delivering operating supplies to the plant. The boat that has since been acquired for this purpose is 116 feet long and is propelled by a 100 h. p. Diesel engine. It has a capacity of about 140 tons. One of its chief cargoes is sulfuric acid which is carried in special tanks installed below deck. The trip from the plant to the dock in Wilmington requires from 2 to 4 hours.

Figure 5 is a flow sheet showing the scheme of operations. Figure 6 shows the general layout of the plant.

OCEAN WATER INTAKE, CANAL, AND POND

The design and construction of the ocean water intake offered an opportunity for ingenuity and engineering foresight. No plans or descriptions of a structure such as it was desired to construct were available. Experience obtained in putting down an intake pipe for the pilot plant indicated that a single row of piling would not survive the pounding of the ocean waves. It had been found, however, that a row of piling on each side of the pipe remained rigid when tied together with a large number of crosspieces. In planning the intake of the new plant, it was decided, therefore, to cut a channel out into the ocean for a short distance and to protect it with a rigid wall on each side. The walls were each to consist of two parallel rows of piling tied together at suitable intervals.

In constructing the intake walls, 50-foot lengths of interlocking sheet steel piling were used. These were driven to a depth of about 42 feet below mean low-tide level. The parallel rows of piling in each wall were joined together at every tenth member by a partition of similar piles at right angles to the direction of the wall. Consequently, when completed, each wall of the intake consisted of a series of interlocked cells 21 feet long and 15 feet wide. These were built, one at a time, beginning at the shore end and were filled with sand that was dug from the channel between them.

Altogether the intake (Figure 7) is about 200 feet long. It extends approximately 30 feet out into the ocean at low tide and about the same distance on to the land at high tide. The channel between the walls is 15 feet wide and the depth is 9 feet below mean low-tide level.

The sea water flows through the intake into a settling basin which is 112 feet long, 76 feet wide, and 12 feet deep. The walls in this case were formed from a single row of 40-foot steel piles. These were left with about 14 feet exposed above mean low-tide level and are about level with the surrounding ground.

The walls of the settling basin had to be supported from the outside in order to keep them from collapsing toward the inside. This was accomplished by bolting 24-inch I-beams to every eighth piece of piling and extending 2.5-inch steel rods about 30 feet out from each I-beam to anchor into timber piling which served as "dead men" to absorb the thrust of the dirt against the piling wall.

In putting down the steel piles, considerable difficulty was experienced in driving the first few members. When these were in place, it was found expedient to use water jets to aid in sinking the subsequent units. A 0.75-inch nozzle was carried down on each side of the piles, and, by forcing the water through the nozzles at 100 pounds per square inch pressure, it was possible to drive them a considerable distance merely by raising and dropping them. When the power required to raise a pile became too great for the derrick, the jetting was continued and a hammer applied to the top of the pile until the latter was driven to the desired depth. In order to keep the piles of the intake walls in perfect alignment so that there would be no difficulty in tying-in the cross partitions, a frame was constructed which was suspended in the air and which kept the piles perfectly straight in their desired location.

Fig. 7—(Right) Sea Water Intake.

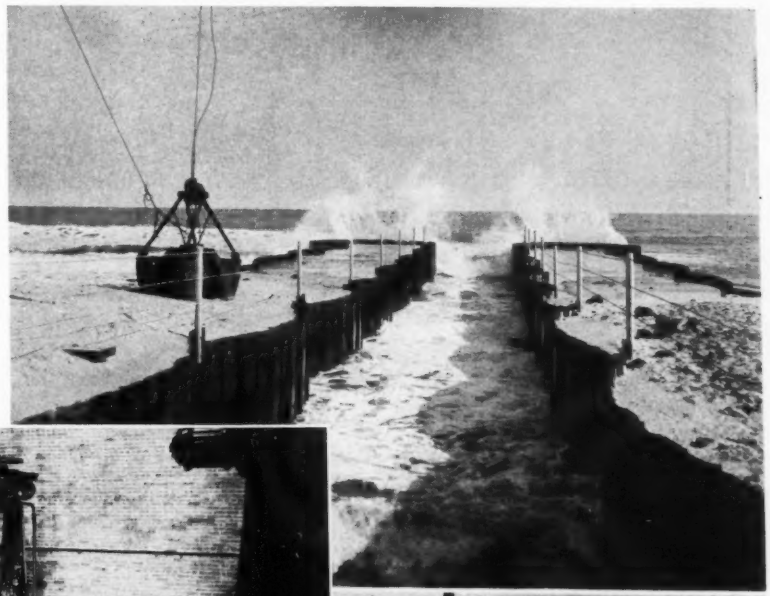

Fig. 8—(Below) Interior of Pump House at Sea Water Intake

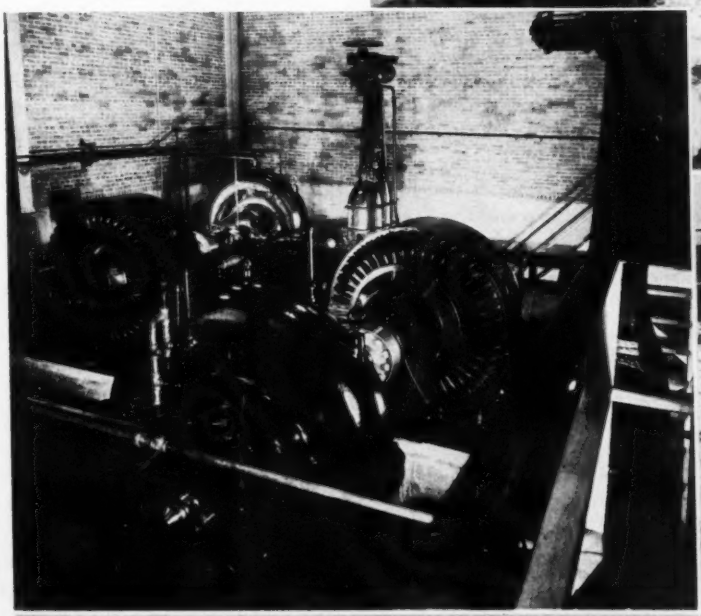

Fig. 9—(Above) Sea Water Being Pumped Over Dam at Rate of 58,000 Gallons per Minute

Figure 10—(Left) Canal and Pond for Passing Sea Water to Bromine Extraction Plant

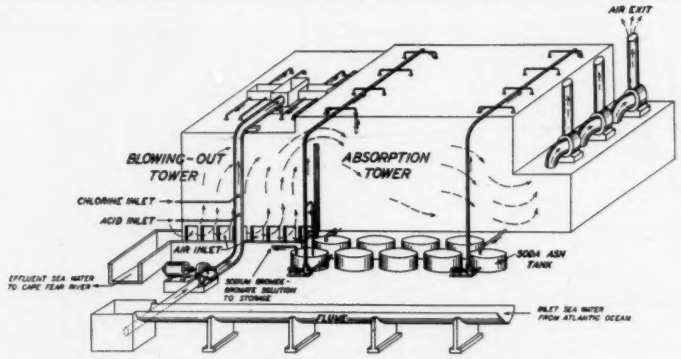

Fig. 11—Diagram of Bromine Extraction Unit

Four concrete compartments were built along the end of the settling basin opposite the intake. At the present time three of these are closed off with plank bulkheads to keep out floating debris. The fourth compartment has installed at its entrance a 120-inch Link-Belt traveling screen which removes floating sticks and other foreign matter.

The pump house, adjacent to these concrete wells, contains two 30-inch centrifugal pumps. One of these has a capacity of about 26,000 gallons per minute and the other can deliver approximately 32,000 gallons per minute. They are operated by 300 h. p. synchronous motors. The intake pipe for the pumps extends 9 feet below the water level at low tide, whereas the screens operate to practically the full depth of the compartment which is 3 feet lower. In starting the pumps a Nash Hytor vacuum pump is employed to prime them. Three to five minutes are usually required to accomplish priming by this method. An interior view of the pump house appears in Figure 8.

Each of the centrifugal pumps is connected to a separate 42-inch steel pipe line which carries the water under a road into a 72-inch steel pipe. The latter conducts the water up over a concrete dam (Figure 9) into a canal and pond. The purpose of the dam is to prevent the emptying of the canal and pond back into the ocean when the pumps are not in operation. The top of the dam is at a level of 23 feet above mean low tide.

The canal is about 6 feet deep and extends about 4,000 feet across the peninsula to the plant which is located close to the shore of the Cape Fear River. Approximately 2,200 feet of the canal are diked off from a pond through which the sea water is by-passed during the summer months. With some 900,000 square feet of exposed surface, the pond permits an increase in temperature during warm weather. This increases the efficiency of the process during several months of the year. After the water has been pumped over the dam and into the canal or pond, it flows to the extraction plant with a loss in head of only about 3 inches. A view of the canal and pond is shown in Figure 10. The pilot plant is visible near the far left-hand corner of the pond.

BROMINE EXTRACTION

The extraction of bromine from sea water takes place in two identical units which are located at the exit of the canal. A diagram of one of them is shown in Figure 11. Each unit consists chiefly of a blowing-out tower in which a current of air removes the bromine from acidified and oxidized sea water, and an adjacent absorption tower in which the bromine is extracted from the air by means of a soda ash solution. The towers are built of bricks and have concrete floors and foundations. The foundations of each unit cover an area 197 x 84 feet. Wood piles 30 feet long were driven in the ground beneath the foundations to avoid any possibility of their settling.

The original ground where these structures are located was excavated to a depth of 9 feet or to a level which is about 5 feet above the river at low tide. This was done to minimize the height that the sea water would have to be pumped to the top of the blowing-out towers.

A horizontal steel flume, which is semi-circular in cross section and 10 feet in diameter, extends between the two extraction units and connects with the canal which brings in the sea water. Because the bases of the towers and the area between them are below the canal level, the flume is carried on steel supports so that it is at the same level as the canal (Figure 12). The absorption towers are located at the end of the flume which is nearest the canal. Hence, the water passes by them on its way to centrifugal pumps which elevate it to the tops of the blowing-out columns. Before entering the pumps, however, the water flows through a traveling screen at the end of the flume. This filters out any leaves or debris which may fall into the water after it enters the canal or pond.

In each extraction unit the sea water is pumped to the top of the blowing-out tower through a vertical 42-inch rubber-lined pipe. Near the bottom of this, a 10 per cent sulfuric acid solution is introduced into the water through a group of small rubber-lined pipes. A short distance higher the chlorine is introduced through similar rubber-lined pipes. At the top of the blowing-out tower the water passes through a series of large and small distributor boxes and pipes so that it eventually is divided up into about 3,200 small streams. These flow down through the tower which is partitioned off into narrow chambers extending the full width of the structure. These chambers are filled with wood packing and are operated in parallel. A stream of air is sucked up through the tower countercurrent to the sea water. The bromine that has been liberated by the chlorine is thus blown out of the sea water, and the latter passes out of the bottom of the tower through exit flumes to the river and thence into the ocean about 12 miles south of the intake. Figure 13 shows a view of the exit flume.

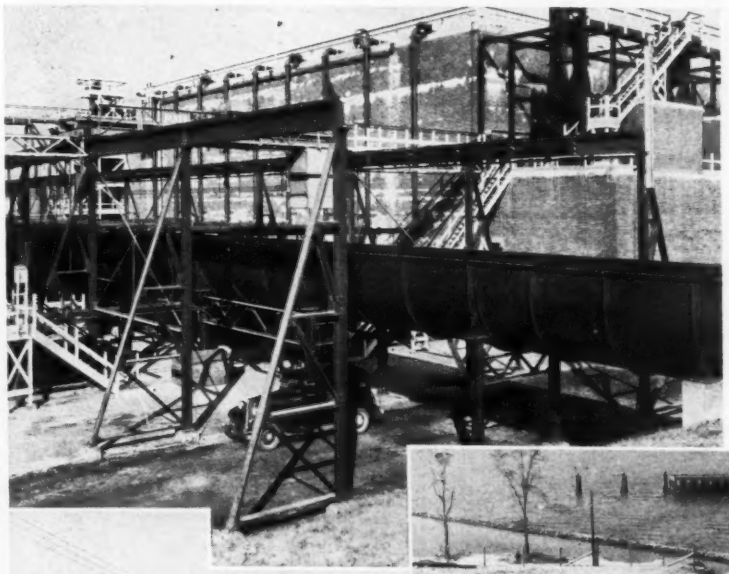

Fig. 12—(Left) Flume for Conducting Sea Water to Blowing-out Towers

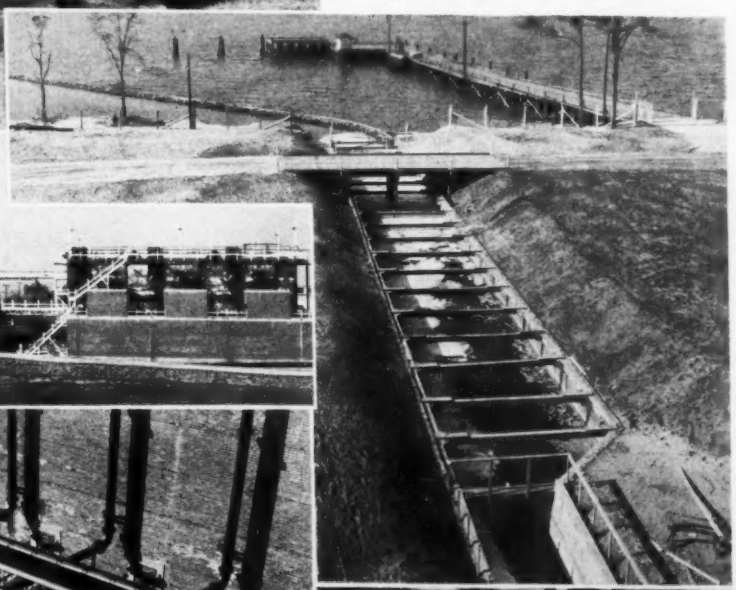

Fig. 14—(Left Center) South End of Bromine Extraction Units

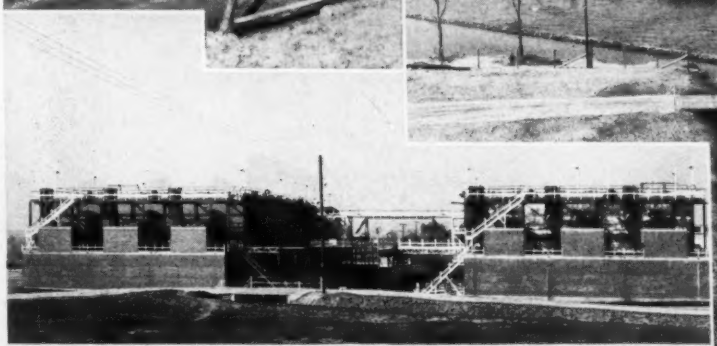

Fig. 13—(Below) Effluent Sea Water Passing from Blowing-out Towers to River

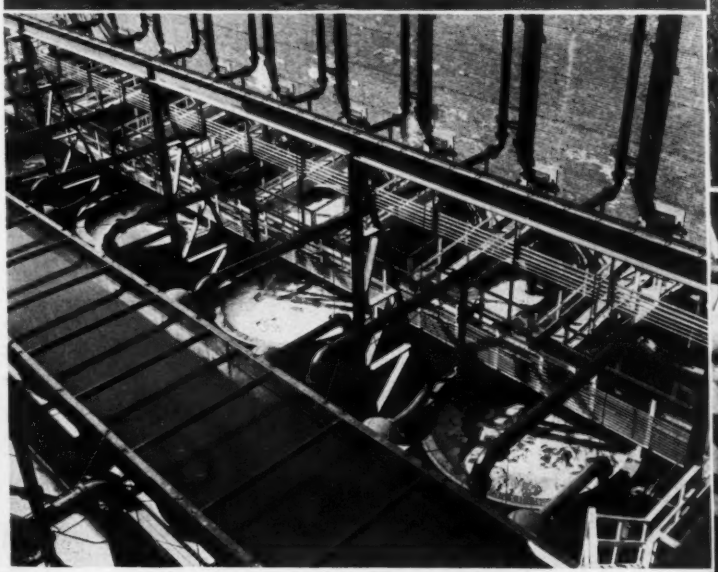

Fig. 15—(Above) Looking Down on Bromine Absorption Liquor Tanks

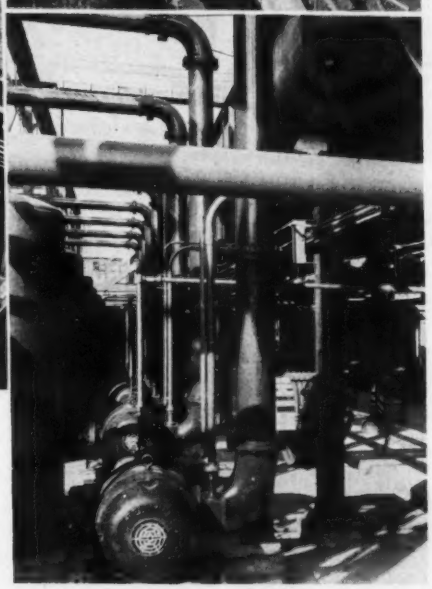

Fig. 16—(Right) Battery of Pumps for Circulating Bromine Absorption Liquor

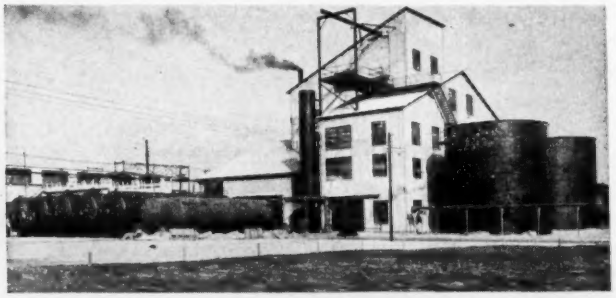

Fig. 17—(Left) Bromine and Ethylene Dibromide Plant

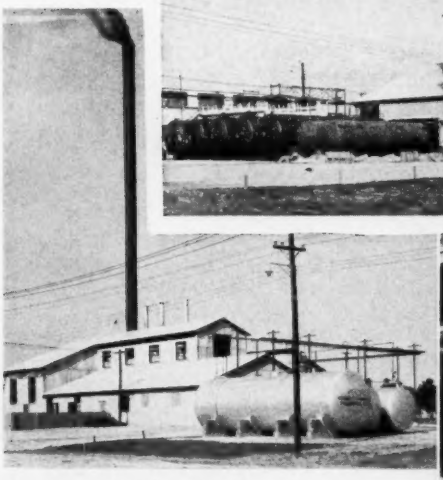

Fig. 18—(Above) Ethylene Plant and Power House

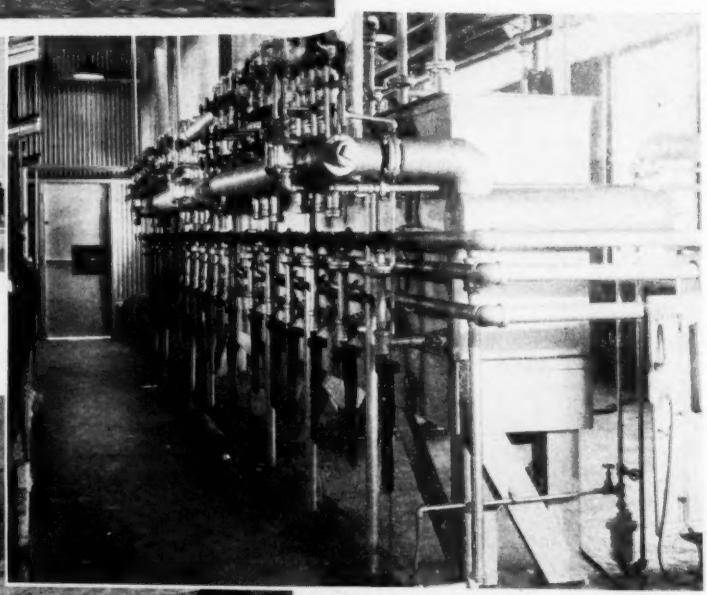

Fig. 19—(Above) Batter of Valves for Controlling Ethylene Production

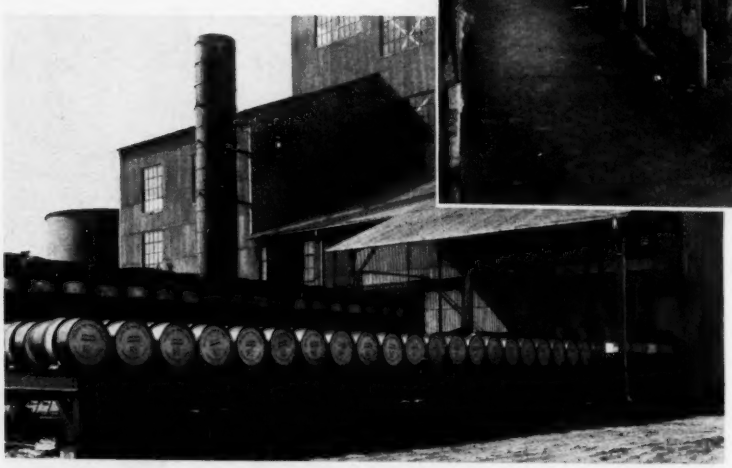

Fig. 20—(Left) Shipment of Finished Ethylene Dibromide

The treatment of the sea water on its way to the blowing-out towers is regulated from the near-by control laboratory. Meters on a wall of the laboratory continuously show both the pH of the acidified sea water and its oxidation potential with respect to bromine liberation. Valves in the sulfuric acid and chlorine lines which lead to the 42-inch vertical mixing pipes are operated by hand from the control laboratory. At a later date it is probable that the control of these valves will be made automatic. Signal lights above the meters also indicate whether the condition of the treated sea water is correct for the flowing-out towers.

The chlorine which is used in oxidizing the sea water is obtained from cylinders having a capacity of one ton. A group of sixteen of these is placed in each of two wooden compartments. These are kept at a temperature of not less than 70° F. The cylinders are connected to the chlorine line and their contents, in liquid form, flow to the chlorine vaporizer. This is a steam-jacketed iron pipe and is located adjacent to the control laboratory.

The sulfuric acid is delivered to the plant in the concentrated form, but it is diluted to a 10 per cent solution before it is added to the sea water. This dilution is accomplished in two rubber-lined tanks, 16 feet in diameter and 10 feet high. These are located adjacent to the control laboratory.

In each extraction unit the air from the blowing-out tower is drawn through its adjacent absorption tower by three fans which are located on a concrete platform at the end of the unit. The air, just before entering the fans,

passes through a small wood-filled chamber which catches any spray of soda ash solution that might otherwise be carried out of the system.

In the absorption tower the bromine is removed from the air by a soda ash solution to form a dissolved mixture of sodium bromide and bromate according to the formula:

$$3Na_2CO_3 + 3Br_2 \longrightarrow 5NaBr + NaBrO_3 + 3CO_2$$

The absorption towers are built on reinforced concrete arches which elevate their floors so as to permit gravity flow of the dissolving liquor into tanks which are located at their bases. This construction also makes possible the detection of any leakage which might take place in the tower bases at any future time.

Each absorption tower is divided into nine chambers which are connected in series so that the air, passing in at the end adjacent to the blowing-out tower, follows in succession through these absorbing chambers and out through the suction fans. Soda ash solution is circulated continuously in each chamber. This is done by pumping it from a tank at the bottom and spraying it in at the top through thirty-six nozzles from which it falls by gravity and drains again into the tank.

At proper intervals the strong bromide-bromate solution formed in the absorption chamber adjacent to the blowing-out tower is pumped to a storage tank. The charges of partially brominated soda ash liquor in the other members of the series are then pumped forward, in turn, to the next tank nearer the one which has just been emptied to storage. When the tank farthest from the blowing-out tower has been emptied, it is charged with a fresh solution of soda ash. Figure 14 shows the south end of the bromine extraction plant. Figure 15 is a view looking down on the absorption liquor tanks and Figure 16 shows the battery of pumps which circulate the soda ash solution. The inlet flume may be seen overhead.

After the bromine from the sea water has been collected in the form of a solution of sodium bromide and bromate, the remainder of the process is performed according to methods which have been previously in use in the industry. The bromide-bromate liquor is treated with sulfuric acid to liberate the bromine. The free bromine vapors are then steamed out of the acidified solution and are condensed into pure liquid bromine. Figure 17 shows the plant in which the bromine is finally obtained in liquid form. The two bromide-bromate liquor storage tanks are seen at the side of the building and the horizontal sulfuric acid storage tanks are in front of it.

The bromine is used in the manufacture of ethylene dibromide which is also made in the building shown in Figure 17. Ethylene is made by passing ethyl alcohol vapor over heated kaolin catalyst to form ethylene gas, which is in turn brominated according to the standard method to form pure ethylene dibromide. Figure 18 shows the ethylene plant and power house which are both in the same building. The battery of valves for controlling the ethylene production is shown in Figure 19. A consignment of finished production the shipping platform of the ethylene dibromide plant is shown in Figure 20.

The power house employs hand-fired boilers and makes steam only for heating and evaporating purposes. Its capacity is about 15,000 pounds of steam per hour at a pressure of 150 pounds per square inch. Operating electric power is purchased from the Tidewater Power Company. It is delivered to the plant at 33,000 volts where it is stepped down to 2,300 volts in two transformer banks.

The entire plant is functioning as anticipated and is removing about 15,000 pounds of bromine per day from sea water. This is being converted into ethylene dibromide at an efficiency somewhat over 90 per cent.

The direct recovery of minerals for industrial use from sea water has long held the attention of chemists, and it is believed that the plant which has been described is the first to accomplish this achievement on a commercial scale of operation. The extraction of gold from sea water in which it is present to the extent of but a few parts per billion has always been the investigator's most fascinating goal, but no success along this line has been reported thus far. Now that the recovery of bromine, which is present to the extent of less than 70 p. p. m., has been successfully executed, it does not seem beyond reason to expect the chemist of the next decade to extract gold from sea water commercially.

Literature Cited

[1]Grebe, J. J., U. S. Patent 1,891,888 (Dec. 20, 1932).
[2]Grebe, J. J., and Boundy, R. H., *Ibid.*, 1,885,255 (Nov. 1, 1932).
[3]Grebe, J. J., Boundy, R. H., and Chamberlain, L. C., *Ibid.*, 1,917,762 (July 11, 1933); Grebe and Boundy, *Ibid.*, 1,944,738 Jan. 23, 1934).
[4]Stine, C. M. A., Ind Eng. Chem., *21*, 434-42 (1929).

. . . The motion picture, "The Magic Key", was then thrown on the screen. . . . (Applause)

President Rose: I wish to thank Mr. Stewart and the Dow Chemical Company for the very great privilege we have had of seeing what is, after all, a very inspiring demonstration of the miracles that can be carried out by simplicity in the hands of those who know how to control the forces of nature.

. . . Following the making of several announcements, the meeting adjourned, at ten-fifteen o'clock. . . .

SATURDAY MORNING SESSION

(Continued from last issue)

C. J. Munter: Mr. Chairman, Members of the Association: I notice from the program that I have been given a doctor's degree. I didn't know it was quite that easy to obtain such a degree and I want to thank the Program Committee for conferring it upon me. (Laughter)

. . . Mr. Munter then presented the paper entitled, "Some Applications of Sodium Metaphosphate to Textile Processes." . . . (Applause)

Proceedings of the American Association of Textile Chemists and Colorists

Some Applications of Sodium Metaphosphate to Textile Processes*

By C. J. MUNTER** and E. B. BELL‡

THE introduction of sodium metaphosphate† into the field of boiler water conditioning provided the engineer with solutions to his problems of boiler water-alkalinity control[1] and feed line-scale formation.[2] We are concerned here with the last of these only, since it represented the first practical application of the power of metaphosphates to prevent calcium deposits and to remove such deposits already formed. Successful use in this manner led logically to the use of sodium metaphosphate as a textile processing agent.

Under power plant-operating conditions, experience demonstrated that the addition of sodium metaphosphate in certain definite excess concentrations governed by the calcium and magnesium content of the boiler-feed water prevented formation of calcium phosphate precipitates in the feed lines of a boiler; and further, that if calcium phosphate or carbonate deposits already existed in those lines, the use of the same proportions of sodium metaphosphate resulted in a gradual dissolution of the deposits until they were removed completely.

The mechanism of this reaction was explained by the ability of sodium metaphosphate to form in solution complex anions, in which calcium or magnesium could be substituted for sodium, in spite of the very low order of the secondary ionization of the complex anion. The low order of this ionization for the calcium-containing ions was demonstrated by the fact that the calcium ion concentration in equilibrium with the complex anion was so low that tricalcium phosphate could not be precipitated from alkaline waters in boiler-feed lines by orthophosphate (PO_4) ion. In fact, the calcium ion concentration in equilibrium with an excess of the sodium metaphosphate was so low that calcium phosphate already deposited would redissolve in the metaphosphate solution until completely removed or until the capacity of the metaphosphate to take up calcium had been reached.

The ability of sodium metaphosphate to prevent the precipitation of and to bring about the re-solution of a large number of other insoluble calcium and magnesium compounds, such as the carbonates, oxalates, sulfates, hydroxies, etc., was quickly appreciated. However, there appeared to be little opportunity for practical use of this property outside of the field of boiler-water conditioning, until some of the most significant applications of this property of the sodium metaphosphate were disclosed by R. E. Hall's discovery[3] that it acted upon calcium and magnesium soaps in alkaline solutions in the same manner as it acted upon inorganic precipitates of those metals. In other words, water could be softened to soap by the use of the metaphosphate without producing any precipitate whatever; in fact, water could be so softened that the addition of calcium and magnesium would not destroy its softness. Furthermore, soap precipitates already formed could be redissolved in alkaline solutions with regeneration of sodium soaps in a form able to enter into action as new soap.

The application of this property of sodium metaphosphate to those processes in which soap and alkalies are used and in which water hardness may be a troublesome factor brings us immediately into those industries engaged in the renovating and processing of textiles. The improvements in quality of work resulting directly from the action of the metaphosphate on "lime soaps," as demonstrated by Gilmore[3], have made it a regular supply in a large number of the laundries of this country and England. Its properties for textile processing have already been indicated to some extent in the literature by Smith[4], Gilmore[5], and Hart[6], but specific processes have not been considered. It is the purpose of this paper to discuss certain of the textile processes in which sodium metaphosphate has been used in practice, pointing out how the material is used and suggesting the reasons for the results obtained.

KIER BOILING

As is well known, the kier boil in cotton finishing is the basis of the entire bleach and is at the same time the source of a great deal of dyeing trouble. Any means of assuring a good kier boil makes comparatively easy the production of good whites after bleaching, and level shades in dyeing. It has been found in practice that the introduction of sodium metaphosphate into the liquor used in kier boiling has been of advantage in several plants.

In the case of one plant mottled or blotchy dyeings were the rule in the dyeing process as a result of poor

*Presented at Annual Meeting, December 8th.

†Sodium metaphosphate is available commercially under the name of Calgon.

**Hall Laboratories, Inc., Pittsburgh, Pa.

‡Calgon, Inc., Boston, Mass.

penetration and lack of leveling. Re-dyes constituted a considerable portion of production, and it was acknowledged that much of the work passed as acceptable was actually sub-standard. In an attempt to overcome the trouble, sodium metaphosphate was introduced regularly over a period of time into the kier liquor in amounts two times as great as that usually recommended for the softening of the quantity of water used in making up the kier liquor. This control was based on hardness tests made regularly in the plant. The kiers were operated at the usual low pressures for from 12 to 15 hours.

Normally, at the completion of the kier boilings involving the use of the metaphosphate there could be noted only one visible change from the usual condition of the kier after a boiling by the regular process. This change consisted of a decrease in the amount of gummy material in the kier. However, in the dyeing operations marked improvements were noted immediately. The penetration and leveling of the dyestuff and brightness of the colors were bettered, indicating that the cloth was definitely in better condition for dyeing. Of still more significance to the plant was a marked drop in the number of re-dyes which, of course, meant far less difficulty in getting out the work.

That these improvements were definitely due to an improved kier boil was checked in the plant by discontinuing the use of sodium metaphosphate in the kier liquor. It is interesting to note that after this step the previous troubles with blotchy dyeings recurred immediately and were corrected again only by adding sodium metaphosphate to the kier liquor.

In another plant jig dyeing of cotton cloth was yielding work of a poor quality. The dyed cloth had a mottled or blotchy appearance of such a nature as to suggest unclean cloth. Because of this appearance sodium metaphosphate was suggested as a possible help for correcting the trouble, with the recommendation that it be used in the kier boil.

When introduced into the kier liquor to the extent of 0.25% of the weight of the goods, sodium metaphosphate produced a marked visible improvement in the kier-boils at this plant. The improvement showed itself first in the better color of the cotton at the kier, using the color obtained in the regular kiering process as a basis for comparison. In the second place, less scum and sludge than were usually present were reported. While these improvements were indicative of a better kier-boil, the full value of the change produced was not appreciated until it was found that the jig-dyeing troubles were for all practical purposes eliminated, and it was possible to turn out satisfactory work where before much of it had to be reprocessed before it could be accepted.

Because of dyeing troubles in the two cases discussed above the effect of sodium metaphosphate additions to the kiers was readily apparent. In other cases where dyeing troubles were not present to emphasize the effect, the use of sodium metaphosphate still produced at the kier improvements in the direction of whiter cotton and less sludge. Subsequent to such kier boils better leveling in dyeing in general has been observed.

While practical results may indicate that sodium metaphosphate is an excellent adjuvant to kier-boiling liquors with or without soap and soluble oils, its exact function in the kier-boiling operation is made somewhat doubtful by the realization that in the course of the kier-boil it reverts to the orthophosphate. This action, of course, makes it impossible to have soft water throughout the kier-boiling process and indicates that whatever action the metaphosphate has must be exerted in the first three or four hours of the process, when the water is completely softened. After that time the gradual precipitation of whatever insoluble calcium and magnesium compounds that may form, as the metaphosphate reverts to form orthophosphate, might yield materials whose state of division would be such as to make them less troublesome than the usual precipitates would be. At least, the possibilities of precipitation throughout the goods itself are less, since by that time much of the material that might have been precipitated immediately on the goods will have previously been taken up in solution in the circulating liquor, removed from the goods, and, if again deposited, thrown down superficially on the goods in such a state as to permit ready rinsing.

With regard to the possible actions of the metaphosphate early in the process the soft water containing an excess of metaphosphate assures freedom from precipitation of insoluble soaps by the hardness of the water and the dissolution of such soaps as may be present originally. The kier-boiling action is thereby not hindered by the presence of such materials in its early stages. Reference to Matthew's[7] quotation of Trotman and Pentecost's work on the effect of hard water on kier-boiling is of significance in this respect. Furthermore, in so far as a hot alkaline liquor will be a better emulsifying medium when soft than when hardness is present, the natural wax of the cotton may be removed more rapidly early in a kier-boiling using metaphosphate, than when the metaphosphate is absent, though the presence of soap or an emulsifying agent may be necessary to realize the full benefit of this action.

There is one other reaction involved in the kier-boiling of cotton that may account for some of the improvement produced by sodium metaphosphate. Pectic substances constitute a large portion of the impurities present in cotton, and the kier-boil is expected to remove these by breaking them down into soluble substances which are then removed by the kier liquor and the rinsing following kiering. One of the major products of the decomposition is pectic acid whose sodium salt is soluble in hot alkaline

liquors, though the calcium salt is very insoluble[8]. Sodium metaphosphate acts upon this salt as on other insoluble calcium salts, preventing its formation and redissolving any already formed in the alkaline liquor. This has been demonstrated under laboratory conditions. Consequently, it is logical to conclude that with sodium metaphosphate in the kier liquor the precipitation of calcium pectate will be avoided as long as metaphosphate is present in amounts sufficient to soften the water, and that as a direct result of this action in keeping such materials in solution, kier-boiling will be improved and perhaps accelerated in its early stages in a manner analogous to the improvement effected by preventing insoluble soap formations. Furthermore, in so far as the original pectic substances include ordinarily insoluble calcium and magnesium salts, which is the case according to Ehrlich as quoted by Matthews[9] sodium metaphosphate in excess in the kier liquor will impart to the kier liquor an increased power for removing pectic substances. Any action in this direction is, of course, of significant value in improving and speeding up the kier-boiling process, since no significant practical means of accomplishing this, other than by alkaline liquors, has been suggested.

The above outline offers a possible mechanism accounting for the improved kier-boiling that attends the use of sodium metaphosphate, and this point is now being investigated from the operating standpoint to determine its bearing on kier-boiling.

BLEACHING

While a good kier-boiling may be expected to prepare the cloth so that satisfactory results will be obtained in the bleaching operation following kiering, in some cases trouble arises in the bleaching and connected operations, these troubles not being traceable to kier-boiling in any way. As is well known the use of sulfuric acid for souring after calcium hypochlorite bleaching, produces in the goods spots of calcium sulfate which subsequently give trouble in dyeing. Generally, these spots are prevented by the use of hydrochloric acid, whose calcium salt is soluble, but the change involves increased costs due to difference in acid costs.

In one plant this difficulty was experienced in the dyeing of cotton warps that had been bleached with calcium hypochlorite, soured in sulfuric acid, rinsed and scoured. The resistant spots produced specks and cloudy effects in the dyed material. As indicated above, to overcome the trouble the plant was forced to use hydrochloric acid in souring all work to be dyed, though on white work sulfuric acid was used without trouble.

Because of occasional dyeing troubles even after the use of hydrochloric acid, sodium metaphosphate was introduced into the scouring operation preceding dyeing in amounts equal to two times the amount required to soften the water of the scouring bath. This recommendation was based upon the observation that the remaining troubles encountered in dyeing appeared to be solely the result of deposits formed in the scouring operation. The modification having corrected the remaining dyeing troubles, the plant wished to make an attempt to return to the sulfuric acid sour in the hope that the sodium metaphosphate would remove the resistant spots formed by the sulfuric acid sour. Operation quickly demonstrated that the plant's hopes were justified, and it was found possible to use the cheaper acid for souring after the bleach on all classes of work without recurrence of the dyeing trouble. It goes without saying that an appreciable saving was effected by that step.

This application of sodium metaphosphate depended entirely upon its ability to act upon those calcium deposits which were present on the cloth at the end of the souring operation, and which could not be removed by the scouring process, as well as upon its power of preventing further deposits in the soap bath during the scouring operation.

While sodium metaphosphate is generally used directly in that process in which troublesome deposits usually form, there are situations that occur in practice where it has been found helpful to use the metaphosphate either earlier or later than at that point where trouble usually occurs. The above example illustrates both cases to a certain extent. When hydrochloric acid was in use, the sodium metaphosphate in the scour assured the operators of freedom from the formation in the scouring bath of those deposits which would interfere with dyeing. Upon return to the sulfuric acid sour, the metaphosphate continued to fulfill this function, while at the same time taking on the additional function of removing those deposits previously formed in the souring operation.

As a somewhat different application in bleaching there may be considered the peroxide-bleaching process used in one mill for cotton, the process in question involving immersion of scoured cotton in a hot alkaline peroxide bath for several hours. During this time the sodium silicate used in this bath "broke down" under action of the appreciable hardness of the well water being used, with the result that the stabilizing effect of the silicate on the peroxide bath was lost. This interfered seriously with the completeness of the bleaching action, and the use of large amounts of silicate in an effort to overcome the trouble imparted harshness to the cotton. By introducing sodium metaphosphate into the bleach bath in amounts sufficient to assure softening of the water throughout the duration of the bleach operation, the precipitation of the silicate was prevented, with the result that it was possible in this plant to bleach cotton successfully with peroxide where before such had not been the case.

DYEING

Consideration of the effects of sodium metaphosphate on the dyeings subsequent to those processes in which it has been used, would lead to the expectation that by its use trouble from precipitation in dyeing processes because of the hardness of the water used would be avoided. In one dyehouse where naphthol colors were being applied to chain warps, scum accumulations on the naphthol bath were consistently giving trouble. This scum attached itself to the material as it passed through the first bath and carried on through the whole dyeing process, with the result that the finished warps crocked severely, besides smudging badly wherever the scum was attached. The introduction of sodium metaphosphate in amounts slightly in excess of the requirement for softening the water of the first bath eliminated the scum formation. Not only did this correct the condition of the dyed goods with respect to smudginess, but this treatment reduced the crocking to a great extent, thus showing the crocking trouble to be closely connected to the formation of the scum. Penetration of the dyestuff was also improved.

At this plant it was found that the sodium metaphosphate solution gave trouble if introduced directly or by carryover on the warps, in too large amounts into the second bath. To overcome this trouble it was found best to keep the sodium metaphosphate dosage in the first bath as low as consistent with scum prevention, whereupon the amounts unavoidably carried over were insufficient to give trouble. As slightly over the softening requirement was sufficient to assure this, no further trouble occurred in the dyeing. Trouble of this type, however, is not universal as in some cases the metaphosphate is of no harm but of apparent benefit in the second bath.

While considering this type of dyeing process it is interesting to note another case involving similar dyes used in a package-dyeing machine. In this case the dyeing was not level, penetration was poor, and crocking was pronounced. The presence of a scum in the machine and on the cloth indicated the cause of the trouble and suggested that elimination of the scum would correct it. To accomplish this, sodium metaphosphate was added to the first bath in an amount sufficient to soften the water throughout the period of use for that bath, with the result that the scum was eliminated. After this better penetration and leveling of the dyeings as a whole was obtained, while the fastness to crocking was increased greatly.

In the two cases just considered the prevention of scum formation permitted satisfactory dyeings to be obtained. However, this scum prevention by the sodium metaphosphate is not the only advantage resulting from the water softening action. The softened dye liquor has been found to effect upon the goods a further cleaning action which supplements the pre-dyeing scour. No results involving cotton solely can be given as examples of this effect, but cases involving the union dyeing of cotton and wool mixtures can be cited.

In one case worsted mill waste and garment factory floor waste containing large amounts of mineral oil were being stock-dyed black and navy blue in pressure machines, the material to be used in woolen mixtures. Before dyeing the stock was always boiled-off with ammonia and soluble oil. This treatment apparently did not remove all of the mineral oil, since after dyeing with direct cotton colors and neutral dyeing union colors with salt in the liquor, the stock contained many undyed specks and unpenetrated knots, and in many instances remained actually oily. The introduction of sodium metaphosphate into these dyeing operations in amounts approximately double the water softening requirements produced some very definite effects. The dyed goods were freed of the oil that scouring failed to remove; the cotton dyed deeper than in any previous dyeings on this type of stock; and better penetration was obtained, the knots being uniformly penetrated and specks being absent.

In the case of the above plant it was quite possible that much the same improvement might have been obtained by using the sodium metaphosphate in the scouring operation preliminary to dyeing, since the betterment in dyeing seemed to be wholly dependent upon cleanliness of the fiber. However, as sodium metaphosphate in the presence of salt has been shown to have a definite emulsifying action on greases and mineral oils[3] there is ample justification for using it in the dye bath, particularly as it may have other valuable properties in dyeing which will be mentioned later.

In another case involving mixed cotton-and-woolen-piece goods, dyeings were made in open kettles after the scouring operation. Even after the most careful scouring the cotton-warp shoddy-filling pieces dyed so poorly that they could not meet requirements. In this case crocking of the dye was severe, and the dye bath scum which smudged the cloth indicated the reason for the trouble. Sodium metaphosphate, introduced into both the scouring and dyeing processes eliminated the scum so that acceptable goods, free of smudges and able to pass the crocking requirements, were produced.

SOLUBILITY OF DYES

The advantages of sodium metaphosphate in dyeing of cotton thus far discussed have been related to the prevention of scums and other deposits by the hardness of the water used in the dyeing baths and to the removal of undesirable materials, such as oil, from the fabrics. In addition to these actions, an important effect on the dyestuffs themselves has been frequently observed in practice. This has to do with the solubility of dyestuffs. The

general observations in this respect have been to the effect that direct and sulfur dyestuffs, and in one case mordant acid dyestuffs, have been made more soluble by the sodium metaphosphate, the effect in the case of sulfur dyes being noticeable in the preparation of the dyes for use. The above statement with respect to direct dyes is based on observations made under plant conditions by one of the writers, and has been confirmed by an independent observer for one direct green dyestuff and in the laboratory for a direct blue dyestuff. For the mordant acid dyestuff the observation was made under plant conditions where attempts to use a brown dyestuff in stock and top dyeing by machine were unsuccessful, because of the poor solubility of the dye. With sodium metaphosphate in the dye liquor it was possible to use this dye in machine dyeing where before this had never been possible.

The value of any material possessing the property of solubilizing dyestuffs is obvious. Even if the time saving involved in preparing dyes is of no significance, the better penetration and leveling action of the dyestuff that are possible are worthy of consideration. Furthermore, the possibility of using dyes that have proved unsatisfactory in some cases because of their solubility is valuable to the dyer.

The solubilizing action of the sodium metaphosphate could hardly be expected to apply to all members of such a large group of chemical substances. In some cases insoluble dyes are not affected; in others soluble dyes are precipitated from the concentrated solutions of dyestuff prepared for dilution in the dye bath; and, of course, in other cases no effect whatever is noted. Of the mordant acid dyes encountered, one bluish-violet dye, that is insoluble in water, was not affected in any way by the sodium metaphosphate. Another bluish-green mordant acid dye, very similar to the above, is thrown from solution upon addition of the metaphosphate to a concentrated solution being prepared for addition to the dye bath. This same action has been observed for one basic dye which gives an orange yellow color on cotton, while many other basic dyes have not been so affected.

In the case of those dyes whose solubility is improved by sodium metaphosphate several factors may be operative to produce the effects noted. The use of soft water or condensate is generally recommended for dyestuff preparation because of effect of calcium and magnesium on many dyestuffs. This condition is provided easily and quickly with even the hardest water by the simple addition of metaphosphate. The excess of this material, since enough is usually added to soften later the whole dye bath, will also be effective in solubilizing any dyestuffs involving calcium in the molecule. Supplementary to this effect there is quite probably a definite action due to the salt concentration provided by the sodium metaphosphate. Effects from this source have been mentioned by Ostwald[10]; whether sodium metaphosphate possesses a more pronounced action in this respect than other salts is not yet definitely known.

In many dyeing operations soaping must be used as a part of the process and wherever the water used in such work is appreciably hard, trouble frequently occurs. While this trouble generally is with the soap deposits formed by the interaction of the water hardness and the soap, a secondary effect but an important one is the reduction in the life of the soap bath due to precipitation of the soap. The bath then fails to remove extraneous scum and dye as it should.

In one vat-dyeing process cotton cloth was being washed in rope form in a boiling soap bath at the completion of the dyeing steps. This operation served to make the colors faster and to brighten them by removing all unfixed dyestuff. However, because of materials carried into the bath on the goods and the hardness of the water, difficulty was experienced in keeping the soaping bath effective in its action. Upon the addition of sodium metaphosphate less trouble was experienced in this respect and the life of the bath was markedly prolonged.

In another case a hot neutral soap bath, in which alkali could not be used, gave consistent trouble from scum and from failure to function during operation. The scum formation was particularly troublesome as it carried on with the cloth to form smudges and spots. By adding sodium metaphosphate in sufficient quantities to keep the bath soft at all times scum was eliminated and the bath life lengthened so that operations could be carried to completion without interruptions.

WOOL SCOURING

The applications outlined above for the various stages in cotton processing suggest in a general manner the applicability of metaphosphate to the same processes involved in work on other fibers. In addition, differences in fiber processing methods provide a number of other interesting possibilities that are not met with in cotton work.

One of the most interesting of those is in connection with the scouring of raw wool. In dealing with a four-bowl train for scouring fleece wool, it was found that soap and alkali were being used in three of the four bowls, the last bowl serving for rinsing. Because of the softness of the water being used it was impossible to save significant amounts of soap and alkali by using metaphosphate in all soap and alkali bowls. It was considered desirable, therefore, to discontinue the soap and alkali in No. 3 bowl in the expectation that the amount of those materials carried by the wool into the water of No. 3 bowl, thoroughly softened by sodium metaphosphate, would continue their action in that bowl since they could

not be precipitated there by hard water. Furthermore, by reason of the dilution of the soap and alkali in No. 3 bowl rinsing would really be started at that point. At the start of operations sufficient metaphosphate was, therefore, added to soften the water in this bowl, and during the run additional metaphosphate was added as was necessary to keep the water soft. To No. 1 and No. 2 bowls the usual amounts of soap and alkali were added at the start, with the operators adding the usual dosages during the run; to No. 4 bowl nothing was added.

After operating on the above basis at the usual plant-production rate, the wool produced had a better color, odor and feel than the regularly scoured stock. The observation that the wool dyed brighter and more level than the regular scouring production confirmed the conclusion that the scouring process was improved.

Comparison of supplies used showed the soap and alkali consumption to be less than usual for a unit of wool scoured, but, of course, the cost of the sodium metaphosphate had to be set against this saving. Comparison of costs then showed that the modified scouring process actually possessed a very slight advantage in cost over the regular process.

In another plant a five-bowl scouring train was being operated, four of the bowls containing alkali, or soap and alkali, with the fifth bowl acting as a rinsing bowl. By arranging to use sodium metaphosphate in the fourth bowl of the train and discontinuing soap and alkali in that operation a marked improvement in the wool over the regular scour was effected. This improvement was reflected in the dyeing operations where brighter colors were obtained on the wool scoured by the modified process. The value of this improvement can be better estimated in the light of the fact that in spite of an increased cost for the process the use of metaphosphate was continued regularly at this plant.

It is interesting to note in this connection that in both of the above plants lime-pulled wool has also been scoured very satisfactorily in so far as the quality of the scoured wool is concerned, without a significant increase in the cost of scouring.

BACK-WASHING

After certain mechanical processes, but usually after the dyeing of wool as slubbing or tops, a process of washing, known as back-washing, is given to the wool. The reasons for giving this treatment vary in different cases, but it is used regularly in many plants. In some cases it serves to remove dirt picked up by the wool in mechanical operations; in others it serves to provide a neutralizing procedure for elimination of acid remaining after dyeing; and in still others it serves to cleanse the wool of the scums that it picks up during dyeing. The general method of back-washing seems to call for a soaping operation followed by rinsing operations, though the exact manner of carrying it out and the equipment used varies widely because of the varying conditions of the wool being handled. Obviously, any material possessing water softening powers would be of value in this process, though it should be apparent that in those cases where scums accumulated in dyeing must be eliminated, the use of the material in the dyeing operation to prevent such scums would be more desirable since back-washing might then be eliminated.

For example, in one dyeing plant it was necessary to back-wash dyed woolen stock because of the invariable presence of a gum, which, hard at some times and tacky at others, interfered seriously with gilling of the wool. By the addition of sodium metaphosphate in the dye bath when dyeing acid and top, bottom and meta-chrome colors, the gum was avoided in the dyed goods and the need for back-washing eliminated.

In other cases where continuance of the back-washing process is of value, there is ample justification for the use of sodium metaphosphate as a water softening agent, particularly in the rinsing operations of the process. That this procedure has worked well in practice is indicated by several cases that might be mentioned.

In one case where the water hardness was appreciable and back-washing was impairing the quality of the product by insoluble soap formation, it was found that markedly less soap was required for this process when the water was softened with metaphosphate, and that the quality of the work was improved by reason of the use of less soap and of metaphosphate-softened water in the rinses as well.

In the other case the stock-dyed wool back-washed in appreciably hard water yielded smelly goods, this trouble being due either to the failure of the back-washing action to cleanse the dyed wool or to the precipitation of soaps in the rinsing. The introduction of sodium metaphosphate into the rinsing operations of the back-washing process in amounts sufficient to soften the water eliminated the trouble from smelly goods. Incidentally a better feel was imparted to the wool by this treatment. This process has been continued in this mill for over one year without recurrence of smelly goods due to the back-washing process.

Forced to use 6 g.p.g. water in scouring piece goods that had been stock-dyed, a third mill found it practically impossible to produce goods that were clean and free from odor. In order to overcome this trouble, sodium metaphosphate was introduced into the soap bath itself, thus eliminating deposits at that point and lowering the soap requirement for scouring. By this single step it was possible to produce goods free from odor and acceptable for marketing. In this case the cause of the change lay

mainly in avoidance of deposits and possibly in improved scouring. Undoubtedly, still better results would have been obtained if the rinse water had been softened also.

In general with regard to scouring operations before dyeing it is well known that soap or alkali, or both, must be added in amounts sufficient to precipitate the hardness of the water completely before any added materials will be available for cleansing action. Consequently, with hard water, insoluble soaps or alkali precipitates are carried in suspension, thus making the bath far from ideal as a cleansing medium. Whenever it is desirable to avoid such precipitates or to assure the removal of such materials from the cloth before dyeing, the addition of sodium metaphosphate is effective in preventing precipitation of soap or alkali by the water hardness and in redissolving the precipitates to be removed from the cloth. However, with relatively soft water the amount of precipitated materials is so low that prevention of deposition in the soap bath is less significant than avoidance of precipitation of soap and alkali directly on the cloth by the hardness of the water used in rinsing. This can be prevented only by softening the rinse water as long as sufficient soap and alkali remain upon the cloth to react with the water hardness. As this would call for complicated feeding equipment and unecomonical amounts of sodium metaphosphate in some cases, a compromise must be reached. This has resulted in the adoption of the practice of rinsing scoured goods continuously until the suds have fallen, whereupon the flow of rinsing water is stopped and metaphosphate is added to the standing bath that results, in amounts sufficient to soften the water as well as act on the deposits formed on the goods. This treatment is continued long enough to assure ample time for action on the deposited materials, and rinsing is then resumed as usual.

OTHER APPLICATIONS

As an indication of the effects obtainable where no difficulty has been experienced in dyeing, there may be mentioned a mill where water of approximately 1 grain per gallon hardness was being used to scour woolen piece goods prior to dyeing. The introduction of sodium metaphosphate into the scouring operations resulted in an improvement in the feel and odor of the goods.

In order to avoid giving the impression that sodium metaphosphate has been a cure-all for cases of sticky and smelly goods, it is well to point out that cases where it has no application have been found. In these instances the cause of the troubles has not always been known, though it has been established in several of them that lime soaps have had no connection with the trouble.

Because of the wide use of acid baths in wool dyeing, sodium metaphosphate would naturally be expected to play a minor part in such dye operations, its value being obtained preferably in scouring operations prior to dyeing. However, it has been used in some cases of wool dyeing with significant results.

One of the authors has observed that in meta-chrome dyeing with a sulfon cyanine dye, sodium metaphosphate used in the dye bath eliminated sludges and scums that were bothersome. On another occasion the same observer noted in the same plant that very poor results were being obtained in dyeing with a common top chrome color, due apparently to poor penetration of the chrome. The blue color desired was not obtained, but in place of it a color varying in splotches from red to plum color. With sodium metaphosphate in the dye bath this trouble with chroming was corrected, and better penetration and level dyeing was obtained. Whether this case of poor penetration was due to dirty goods is not known, but that the metaphosphate plays some part in producing better penetration has already been indicated in the case of cotton and wool mixtures, where better penetration of the dyestuff on cotton produces deeper shades accompanied the use of the metaphosphate.

Because of the use of a wide variety of materials in sizing rayons during their manufacture, the scouring or boiling-off and dyeing of rayons has brought up some interesting problems. In one case an oily substance present on the rayon in combination with scum formed by water hardness in the scouring bath gave a gummy material which spotted the rayon badly. Softening of the scouring bath with sodium metaphosphate in this case prevented scum formation with the result that the oil was well emulsified by the soap and spotting of the cloth prevented.

In another mill dyeing and finishing rayon, the metaphosphate was found to be valuable not only for spot prevention in both scouring and dyeing operations, but also for its effect on dye penetration when dyeing certain types of heavy fabrics. It was found that wherever these fabrics were scraped after dyeing, a streak was produced on the fabric. Investigation showed this unusual trouble to be due to differences in the depth of color between the outer face of the surface threads and the under face. In handling, the movement of the threads brought the lighter colored surfaces to the face of the the cloth, and an unusual uneven color effect was produced in many places. In this case the use of sodium metaphosphate in the dye bath to correct other spotting troubles was found to correct this difficulty automatically, thus providing another instance in which this chemical seemed to demonstrate a penetrative or leveling action in dyeing.

In the processing of silk, sodium metaphosphate has been used in practical work only in the dyeing of piece goods, the effect desired being mainly the prevention of spotting of the goods by scums on the dye liquor and deposits in

the dye boxes. Effects on dyeing processes unrelated to the above action will probably be found as in the case of other fabrics, but no effort has been made to obtain information in this direction as yet.

In the case of one large silk-dyeing mill, spotting occurred on the colored pure-dye pieces to the extent of 14 per cent of the pieces dyed in a period of 30 working days, in spite of the fact that the boxes were washed at least once for every four dyeings. In these dyeings the effect of the hardness of the 4 to 5 grain water in producing precipitates with the inorganic agents added to the dye bath was obvious, these precipitates forming immediately throughout the bath at its start and collecting to form scums during the continued heating with live steam while dyeing proceeded. These scums were accompanied by gummy soap deposits in those cases where soap was introduced into the dye bath by the pieces because of poor washing after boiling-off. By introducing sodium metaphosphate into the dye bath in amounts sufficient to assure softening of the water throughout the dyeing, the inorganic precipitates were visibly eliminated as the liquor before dye additions remained clear. Soap deposits were also prevented, whenever soap was introduced by the boiled-off cloth. These changes resulted in a reduction of the incidence of soap spots for a 30 working day period to 4.2 per cent of the pieces dyed, without washing the boxes at any time during the period.

In dyeing weighted silk in the same mill, with sulfonated oil as a supplementary agent to the other dyeing materials, soap spots occurred on 4.1 per cent of the total number of pieces dyed over a 30 working day period, during which the boxes were washed at least once in every four dyeings. In this case the formation of precipitates in the dye liquor was not detectable, but gummy deposits developed regularly on the surface of the dye baths under the prolonged heating of the dyeing operation. As the formation of the gummy deposits due to soap entering the bath on the cloth was not likely, the deposits appeared to be due to the sulfonated oil or soap in it. In any case, the addition of sodium metaphosphate to the bath definitely minimized this formation with the result that spotting was reduced to 1.1 per cent of the pieces dyed during a 30 working day period without having any box washed at any time during the series of dyeings.

It goes without saying that this effect is very valuable in those plants where such spotting delays the production of work and necessitates special treatment for the fabrics before they can be finished.

The above discussion is of interest in indicating the variety of uses to which sodium metaphosphate, a relatively new chemical to the textile field, has been put in practice. Most applications thus far developed have been connected with the softening of water and the removal of calcium and magnesium soaps from water and goods. Further uses of the material in this same capacity can be undoubtedly expected, as water is undoubtedly involved in more textile processes than any other material, and wherever water is used, the textile worker must deal with its hardness.

Practical use of this chemical has also indicated that it may possess many other valuable properties from the textile processing standpoint of which very little is known at present. However, if the indications are borne out upon investigation, this chemical will have many additional textile applications not connected with its water softening properties.

References

[1]U. S. Patent No. 1,903,041.
[2]U. S. Patent No. 1,956,515 (April 24, 1934).
[3]B. H. Gilmore, Starchroom Laundry Journal, *40* 24-34 (Oct., 1933).
[4]G. W. Smith, American Dyestuff Reporter, *23*, 161-170 (1934).
[5]B. H. Gilmore, American Dyestuff Reporter *23*, 642-5, and 652 (1934).
[6]Ralph Hart, American Dyestuff Reporter, *23*, 646-650 (1934).
[7]J. M. Matthews, Bleaching and Related Processes, The Chemical Catalog Co., Inc., 1921, pg. 262.
[8]R. A. Gortner, Outlines of Biochemistry, John Wiley and Sons, Inc., 1929, Chapter 27.
[9]J. M. Matthews, The Textile Fibers, John Wiley and Sons, Inc., 1924, pp. 481-2.
[10]Wolfgang Ostwald, The Colloid Aspects of Textile Materials and Related Topics, The Faraday Society, September, 1932, pp. 347-351.

President Rose: This paper again illustrates the value of introducing new methods of doing things. It is unfortunate we have no time for discussion of it.

We will go over the next paper which is on an entirely different subject, that of "Selling," by A. R. Thompson, of the Ciba Company, an old friend of ours in a new guise. (Applause.)—Due to lack of space in this issue, Mr. Thompson's paper will be published in the next issue. Charles B. Ordway followed Mr. Thompson and presented a paper on "The Progress of Textile Research in the South."

Prof. Charles B. Ordway: Mr. Chairman, Fellow-Members of the American Association of Textile Chemists and Colorists: Our reaction to talks on research and other technical subjects reminds me very much of the story about two Carolina darkies. The first darkey had a very beautiful gold watch. He couldn't tell the time of day. Neither could the second one. The first one always took his watch out and proudly displayed it. He would look at it with great glee and make all the rest of the darkies envious.

The second one, one day, said, "What time is it, Sam?"

Sam took the watch out, showed it to him, and said, "Here it is!"

That is usually our reaction, both of the layman, and the technical man, to research topics.

. . . Professor Ordway then presented his prepared paper . . . (Applause.)

Proceedings of the American Association of Textile Chemists and Colorists

The Progress of

Textile Research in the South*

By CHARLES B. ORDWAY†

THE title of this article may be a trifle misleading through the use of the term *Research*. This word has been much abused and the writer feels that "studies" or "advanced testing" usually defines our minor research investigations more accurately.

Minor research work may soon grow into major and real research studies when the investigator picks a suitable and rich field for investigation. With this in mind the writer has endeavored to secure a brief summary of the advanced textile study and research that have been completed recently and that which are still in progress in the Southern colleges and textile schools, and make this information available under a single heading for all persons who may be interested.

Because of the extensive work under way, the various subjects are summarized only briefly and all those who may be interested in any of these particular subjects may secure fuller information from the respective institution where the various studies have been made or are in progress.

The Textile Chemistry and Dyeing Department of the Textile School of North Carolina State College, Raleigh, North Carolina, reports:

1. "A series of cooperative studies with mills." These involve dyeing, bleaching, dry cleaning, and related problems.
2. "Cotton Versus Jute Bagging." The college in cooperation with U. S. Governmental agencies.
3. "Cooperative Studies with the Committees on Sulfonated Oils of the A.A.T.C.C. and A.O.C.S."
4. "The Penetrating Action of the Newer Sulfonated Alcohols."

Under the direction of Prof. Grimshaw, highly valuable technical data on the analysis of sulfonated oils and the testing of starches have been carried out at this college. These investigations have been published in the leading textile and chemical journals.

The University of North Carolina, in conjunction with the Textile Foundation has carried on an extensive study of the disposal and recovery of textile wastes. The published reports on this work up-to-date are: (1) "The Effect of Precipitants on Textile Waste Liquors." (2) "The Disposal and Recovery of Textile Wastes," Part I. This work is still in progress and a well engineered pilot plant has been built at Greensboro, North Carolina, for the continued study of this problem.

The Textile Department of Texas Technological College, Lubbock, Texas, reports the following studies as completed and published in textile journals.

1. "Staple Characteristics of Some of the Different Varieties of Cotton."
2. "Fiber Qualities of Importance to the Spinner."
3. "Effects of Drought on Cotton Staple."
4. "New Twist Formula for Cotton Yarns."

Subjects Under Way:

1. "Effects of the Method of Harvesting Cotton on the Waste Loss in Carding and Final Yarn Qualities."
2. "Effects of Sizing of Different Yarns on Weight and Strength."
3. "A Complete Analysis of the Bleaching Process. Effect of each step on cloth weight, strength, and appearance."
4. "Spinning Various Single Lengths on Long Draft Frame."
5. "Table of Derivative Colors from a Series of Related Dyestuffs."

Studies that have been completed and published at the Virginia Polytechnic Institute, Blacksburg, Virginia, under the direction of Dr. P. C. Scherer, Jr., are: (1) "The Action of Sodium on Cellulose in Liquid Ammonia." (2) "Solubility of Cellulose in Ammonia Salt Solutions." (3) "Factors During Spinning Which Influence the Physical Properties of Rayon." Parts I and II "Sulfur Forms in Crude Viscose Rayon Yarn."

Studies under way include extensions of some of the above subjects and new projects on the chemical engineering side of rayon production.

The investigational work at this college has dealt mainly with the commercial types of wood pulp as now made and used in this country.

The Textile Department of Texas A. & M. College, College Station, Texas, reports investigations on "Cotton Spinning Tests, comparing various qualities and methods of Harvesting from the Spinning Viewpoint."

Studies under way at the Georgia School of Technology, Atlanta, Georgia:

*Presented at Annual Meeting, Dec. 8th, 1934.
†Alabama Polytechnic Institute.

1. Converting rayon waste into yarn: An investigation of the treatment necessary, both chemical and mechanical, in the conversion of ordinary rayon waste, as it occurs, into a yarn suitable for textile use.
2. An investigation of the suitability of slash pine pulp for the manufacture of viscose rayon: A project beginning with the paper pulp and carrying this through to the finished yarn and fabric.
3. An investigation of methods for the separation and analysis of union materials.
4. The selection of "suitable" colors for the dyeing of rayon and mercerized cotton, this to include a study of test methods that may be employed to determine the suitability of colors for use in the dyeing of these fibers.
5. The sizing of rayon yarns: A study of sizing materials and methods that may be suitably used in the sizing of rayon warps, this investigation to include weaving and tests on the finished goods.

The subject that has created wide interest at this institution is the making of viscose rayon from the paper pulp that was obtained from Southern slash pine. This work follows in the steps of Dr. Chas. Herty's work at the Savannah Research Laboratories, on paper manufacture from slash pine.

The Textile School of Clemson College, Clemson College, South Carolina, reports the following studies as competed:

"The Dyeing of Cotton-Rayon Unions."

"The Effect of pH in Dyeing Viscose with Direct Dyes."

"The Physical Effects of Commercial Bleaches on Cotton Fibers."

"A Synthetic Fiber Prepared from a Gelatine Base."

"An Investigation of the Possibilities of Raising the Wet Strength of Viscose Rayon."

"Mothproofing of Wool."

"The Effect of After-Treatment on the Fastness to Light of Vat Colors."

"Possibilities of a Cellophane Substitute from a Gelatine Base."

"The Effect of Increasing the Picks Per Inch on the Warp and Filling Breaking Strength."

"What Number of Test Specimens Is Necessary to Get a Reliable Average of the Breaking Strength of Cotton Sheeting."

"A Study of Cellulose Acetate to Determine Its Suitability for Processing Jacquard Harness Lines."

"Comparative Test to Determine the Effect of Various Rayon Oils on the Knitting Qualities of Viscose Rayon."

"Effect of Relative Humidity on the Physical Properties of Rayon Yarn."

"Spinning Test of Picked and Snapped Cotton."

"To Study the Effect of the Variation of Twist on the Creping Qualities of Rayon."

"A Comparison of the Actual and Theoretical Yarn Contractions in Weaving Plain Fabrics."

At Auburn, Alabama, the National Bureau of Standards and the Alabama Polytechnic Institute, are engaged in a cooperative research, which has for its major objective the utilization of sweet potato starch in the textile industry. This work includes an investigation of the fundamentals involved in the slashing of cotton warp yarn, methods of test by which a sized warp yarn and starch size may be evaluated, and securing comparative information on the relative merits of the various starches as warp sizing agents.

Papers

"Consistency of Potato-Starch Size," Schreiber, Geib, and Moore. Bureau of Standards Journal of Research, Vol. XI, p. 623.

"Sizing of Cotton Warp Yarn." Schreiber, Geib, and Moore (submitted for publication). Bureau of Standards Journal of Research.

Further studies completed at the Alabama Polytechnic Institute are:

1. "A Study of the Colloidal Nature of Sweet Potato Starch." O. C. Moore.
2. "Strength and Wearing Properties of Textile Fabrics." L. B. Haley, Textile Foundation's Fellowship.
3. "New Possibilities in the Lubrication of Textile Fibers"—C. B. Ordway.
4. "The Determination of a Method for the Measurement of the Resistance of Sized and Unsized Cotton Yarns to the Abrading Action of the Weaving Operation: A Method for the Evaluation of Sweet Potato Starch. C. B. Ordway".

The construction of a small pilot for the experimental study of textile and industrial wastes at this institution has been completed. This plant is available for experimental operation in conjunction with the Engineering Experiment Station of the college and the industrial plants of Alabama and the Southeast.

Studies Under way:

1. "A Study of Comparative Bleaching Methods and Tests on Cottons".
2. "An investigation and Determination of Materials Suitable for use in Sizing Compounds whereby the Colloidal Nature of the prepared size is improved and its Consistency is maintained during the Slashing Operation".

This latter study will be carried out through the cooperative efforts of the writer and Mr. Ralph Hart, who is a well known authority in the textile chemical industry.

President Rose: It is very interesting to hear of the activity that is taking place in the technical schools and colleges of the South in facing these very important industrial problems, because that is what it amounts to, and I congratulate Professor Ordway on the courage with which he and his associates are attacking these very difficult problems.

The next paper is one which I am sure will be of great benefit to all of us. "The New Textile Technology," by one who is an authority, Professor E. R. Schwarz, of the Massachusetts Institute of Technology. Professor Schwarz! (Applause).

Professor E. R. Schwarz: This is to be largely a comparison by means of some crude but I hope effective analogies between the old textile technology and the new textile technology, so-called.

. . . Professor Schwarz then presented his prepared paper, illustrating with slides. . . . (Applause.)—This paper will be published in the next issue.

AN OPEN LETTER

to Manufacturers of Chemical Specialties for the Textile Trade

273 Converse Street
Longmeadow, Massachusetts
January 18, 1935.

Gentlemen:

A year ago the American Association of Textile Chemists and Colorists published for the first time in its 1933 Year Book a list of chemical specialties for the textile trade. The responses from manufacturers and importers were so encouraging for the first year and so many favorable comments have been received from our members in textile mills that this department of the Year Book will be continued. Although invitations are being sent directly to those offering chemicals to the textile industry to catalog their specialties in the Year Book, this letter is published openly in the AMERICAN DYESTUFF REPORTER so as to reach those who may otherwise be inadvertently overlooked.

In the new Year Book we shall follow the same policy as expressed in the original resolution passed by the Council, namely that "The list of products for textile processing shall be limited to homogeneous substances or mixtures for which the chemcial formula or complete qualitative composition or method of manufacture is given by the seller." In order to restrict the size of the list just as we did before, however, we shall not include common heavy chemicals or sulfonated oils, both types of which products are indispensable to the textile industry. Furthermore, it is obvious that products of which, for competitive reasons, the manufacturer can not give the composition can not be included even though they have a very useful place in the processing of textile materials. On the other hand, foreign as well as domestic products may be included.

The nature of the information required by the committee can best be understood by a study of pages 312 to 322 in the 1933 Year Book. Briefly, we require the following:

1. Firm designation, limited to four letters and conforming to or not interfering with the abbreviations used in the Tabulation of American Dyes.
2. Commercial name of chemical specialty.
3. Principal uses, very briefly.
4. (a) Systematic chemical name or chemical formula, if an essentially pure substance; or
   (b) Complete qualitative composition, if a mixture; or
   (c) Method of manufacture, very briefly, with names of raw materials.

The data above should be sent to the Chairman as soon as possible. The cooperation of manufacturers and importers will be very greatly appreciated.

Very truly yours,

CARL Z. DRAVES, *Chairman,*
Committee for Textile Specialties

STANDARD SILK SAMPLES

There have been prepared, under the direction of the Sub-Committee on Fastness of Dyed Silk, standard dyed silk fabrics to represent four classes of fastness to washing—namely, Class I, Class II, Class III and Class IV. These standards have been carefully dyed with the dyestuffs and according to the dyeing methods recommended in the 1931 Year Book.

The A. A. T. C. C. is prepared to furnish sets of these washing standards for a nominal charge which will cover the cost of preparation. It will be possible to accurately grade the fastness by comparing it with the standards after subjection to the standard washing tests approved by this Association. All inquiries concerning these Silk Washing Standards may be addressed to the Chairman of the Research Committee.

Louis A. Olney,
Lowell Textile Institute,
Lowell, Massachusetts.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the secretary any vacancies which may occur in their businesses.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive

Note. Persons who have obtained employment should notify the secretary at once. Prospective employers may file vacancies either with the secretary or the American Dyestuff Reporter.

A-3

Education—Ph.B., Brown University, 1920. Two years post-graduate work at M.I.T.

Experience—2 years instructor at M.I.T. 2 years as research chemist in print works (Gum thickenings, application of dyes, dye testing and evaluation. 4 years as chief chemist in bleaching, mercerizing, dyeing and finishing plant. 4½ years as research and plant chemist in silk mills (Colorimetric work in color matching, dye testing and identification and testing of chemicals). 2 years as organic research chemist (laboratory and semi-plant research on organic chemicals, intermediates and dyestuffs). Age 35, married. Will go anywhere, references.

A-5

Education—B.T.C., Lowell Textile Institute.

Experience—Assistant chemist in carpet mill, dye tester in dye plant, research and analytical work in silk dyeing and finishing plant laboratory, plant chemist and overseer of bleaching in surgical dressing plant, assistant chemist in woolen mill. Age 29. Married.

A-B-2

Education—Lowell Evening Textile School, 1917.

Experience—Five years' experience in hosiery dyeing, full fashioned hosiery of silk and cotton and silk, also men's hosiery containing rayon, wool, cotton and celanese. Several years experience in laboratory work. Has also had experience in jig-dyeing of cotton piece goods, slub and top dyeing.

A-B-3

Education—1 year Conn. Agricultural College, Extension course in chemistry at Trinity College and R. I. School of Design.

Experience—3 years laboratory research on guaranteed washfast and sunfast colors on silk, cotton and rayon. 2 years dyer on skeins (all fibers and all types of dyeing). 1½ years as dyer in charge of adapting vat and naphtol colors to machine processes for cotton threads. 1 year as chemist and dyer on narrow fabrics. Will go anywhere; references.

A-B-C-1

Education—Graduate Industrial Chemical Engineer, Pratt Institute—1911.

Experience—One year as plant control chemist, 4 years as laboratory chemist with gas company, 13 years as plant chemist with bleaching, dyeing and finishing plant. (Rayon and cotton piece goods). Formulated processes and put them into plant operation, 1 year as chemist and demonstrator for dyestuff company, 1 year as superintendent colorist with print works printing linen and rayon, 1 year as director of testing laboratory for national dry goods concern.

A-B-C-2

Education—Graduate of Lewis Institute of Engineering of Chicago and graduate of Philadelphia Textile School (Chemistry and Dyeing department).

Experience—Has had extensive experience as assistant chemist and colorist in silk printing, dyeing and finishing; also dyeing raw stock wool; and dyeing and finishing cotton and rayon. Age 30; married; references.

A-B-D-1

Education—Graduate, New Bedford High School, 1930; New Bedford Textile School, 1933 (chemistry, dyeing and finishing).

Experience—16 months' general experience in print works, on all type machines and special experience in application of direct, sulfur, developed and naphtol dyes and color matching. Desires position in dyehouse, laboratory or sales. Age 22; references.

A-C-1

Education—4 years at Newark Evening Technical School in Chemical Engineering.

Experience—8 years in manufacturing, research, testing of soaps, oils, gums and finishes and application of same in all phases of the textile industry. Age 23, single. References.

A-E-1

Education—Ph.D., Univ. of Illinois, studied chemical engineering at Columbia, licensed chemical engineer, New Jersey.

Experience—10 years' experience teaching in colleges, subjects included chemical and textile subjects. Has had broad experience in industrial work including experience in testing materials, research and consulting. Will go anywhere; references.

B-1

Education—Educated and trained in chemistry and calico printing in Glasgow, Scotland.

Experience—Has been with large print works as colorist for 13 years producing first class work on cotton, rayon, wool and silk fabrics. References.

B-2

Experience—Boss dyer with one firm for 18 years, divisional supt. at print works for 1 year, in charge of processing and dyeing of cottons and rayons at large bleachery for 6 years. Prefers bleachery in East but will go anywhere. References.

B-3

Experience—Foreman piece dyer for the past 21 years. Can dye the following; celanese, rayon, cotton lacks, wool, silk and mixed fabrics. Has knowledge of finishing and laboratory work.

B-6

Education—Graduate R. I. School of Design.

Experience—5 years in bleachery, 7½ years as assistant dyer, 2 years as boss dyer and 3 years as superintendent of dyeing and finishing. Married, 33 years old. References.

B-7

Experience—Eight years as boss dyer on skeins and ribbons. Over ten years as chemist and head dyer for a large hosiery mill. Experienced on Silk, cotton, rayon and wool in skeins, ribbons, piece goods and all kinds of mixtures. Willing to go anywhere. Not afraid to work or face responsibility. Can handle help efficiently.

B-8

Education—Chemistry and Dyeing Department, Philadelphia Textile School.

Experience—Eleven years experience as chemist and boss dyer on the following: woolen, worsted and cotton yarn; woolen, worsted and union piece dyes on both ladies' and men's wear; wool, cotton, shoddy and mohair raw stock. Age 33, married, will go anywhere. References.

B-9

Experience—Hosiery dyer with fifteen years' experience on high grade silk hosiery; familiar with all types of machines. Age 43, married. Will go anywhere.

B-12

Education—2 years days at N. Y. U. and 3 years nights studying chemical engineering.

Experience—1½ years asst. colorist, 5½ years colorist. Experienced on vats, commercial and fast colors on cotton and cotton-rayon mixtures. References; age 29; married.

B-13

Experience—Large experience as an assistant colorist chemist in silk printing, dyeing and finishing; also on cotton and wool dyeing. References.

B-14

Education—Rhode Island School of Design.

Experience—Familiar with all classes of wool dyeing. Seven years with large carpet mill as dyer and processor of washed oriental rugs. Will go anywhere, married, 37 years old. References.

B-15

Education—B.T.C., Lowell Textile Institute, 1934.

Experience—Experience in dye house running washers, dye kettles and as a dye weighter.

B-16

Education—Chemistry and Dyeing Dept., Philadelphia Textile School.

Experience—Head dyer and chemist on all types of hosiery; dyeing silk, cotton, Bemberg, rayon and unions of same; Celanese and immunized cotton effects. Age 27, married. Will go anywhere.

F-1

Education—Textile Institute, Alexander Hamilton Inst., Extension work at Brown Univ., working knowledge of German.

Experience—Has had executive departmental work with all types of textiles manufacturers. Acquainted with all types of textile machinery, dyestuff application, laboratory practice, cost methods, and checking methods and processes. References.

APPLICANTS FOR MEMBERSHIP

(Continued from page (21) 29)

George H. Wood—Chemist, The Apponaug Co., Apponaug, R. I. Sponsors: William H. Cady, Nelson Barlow.

Junior

Gustave E. Friedrichs—Woonsocket Dyeing & Bleaching Co., Woonsocket, R. I. Sponsors: John G. Masson, Raymond J. Morin.

George H. Hotte—Research Assistant, Mass. Inst. of Tech., Cambridge, Mass. Sponsor: E. R. Schwarz.

William E. Smith—Textile Colorist, General Dyestuff Corporation, Philadelphia, Penna. Sponsors: Emil C. Hansen, William C. Robb.

Frederick V. Traut—Laboratory man, Globe Dye Works Co., Philadelphia, Penna. Sponsors: Robert A. Bruce, Elmer C. Bertolet.

Associate

Charles H. Clark—Secretary, U. S. Institute for Textile Research, Boston, Mass.

Herman E. Kiefer, Jr.—Purchasing Agent, Ware Shoals Mfg. Co., Ware Shoals, S. C.

David C. Scott—Treasurer, Henry L. Scott Co., Providence, R. I.

Student

George F. Bohorfoush—Alabama Polytechnic Institute. Sponsor: C. B. Ordway.

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LOUIS A. OLNEY, Sc.D.
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

NORMAN A. JOHNSON
Managing Editor

MYRON DREW REESER
Advertising Manager

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GOVERNMENT RECEIPTS

WE NOTE that for the first seven months of the current fiscal year the U. S. Treasury receipts amount to over $2,000,000,000 with five months yet to go before the end of the year is reached. We are informed that this is a record amount for the past five years and also that the revenue of the government represents an increase of 23 per cent over last year. The figures involved, as published on January 22nd were: receipts to date this year $2,006,292,977; income to date a year ago, $1,624,535,520; increase over last year, $381,761,456. Expenditure figures compare as follows: this year (over income), $1,878,739,823; last year (over income), $1,699,276,282; increase over last year, $179,463,540. If private business concerns could show equally sharp gains in their receipts, there would indeed be cause for jubilation. However in discussing the government's income we must take into consideration the fact that the government has made no attempt to keep its expenses within its income. This makes any real increase in receipts of little value.

This increase has been due in part to the imposition of new taxes. Among these is the processing tax on farm goods and, following the repeal of the Eighteenth Amendment, taxes on liquor. These taxes account for about one-quarter of the total collected. Other taxes which have been in effect for some time have shown corresponding increases; income tax receipts are up 27 per cent over last year and other taxes are yielding about 13 per cent more.

Such statistics as the above are of little comfort when we realize that the government continues to pile up a huge deficit which is increasing, rather than decreasing, as we go along. The best we can get out of these comparative figures is the assurance that when we finally do start to make up this deficit we shall have an efficient tax-collecting system to function.

● DYE IMPORTS

The value of United States coal-tar dye imports entered for consumption during 1934 continued to increase, being 5 percent greater than for the preceding year and 43 percent in advance of that for 1932, according to C. C. Concannon, Chief of the Commercial Department's Chemical Division.

Mr. Concannon pointed out, however, that a part if not all of the invoice value increases in 1934 was probably due to dollar depreciation as the quantity imported during that period was the lowest in three years.

A total of 3,392,500 pounds with an invoice value of $5,033,300 was entered for consumption during 1934 compared with 4,288,200 pounds valued at $4,792,000 in 1933, and 3,904,600 pounds valued at $3,517,000 in 1932. The unit invoice value of $1.48 in 1934 compares with $1.11 in 1933 and $0.90 in 1932, statistics show.

Germany and Switzerland supplied practically all coal tar dyes imported into the United States during 1934 with only small amounts coming from England and elsewhere, Mr. Concannon stated. Germany was supplying approximately 58½ percent of the total in January, Switzerland more than 40 percent, and England, a little more than 1 percent. As the year advanced, however, there was a tendency for Switzerland to obtain a larger share of the trade until in December when Germany and Switzerland were supplying approximately 50 percent each with less than two-tenths of one percent originating in England.

Practically all of the 3,363,000 pounds of coal tar dyes imported for consumption during the year were entered through the port of New York, with Boston, Newark, Philadelphia and Albany each receiving a few small consignments.

Imports of aromatic chemicals declined considerably, both in quantity and value, only 24,350 pounds valued at $48,725 being entered for consumption during 1934 compared with 46,050 pounds valued at $74,200 for the preceding year. Receipt of coal tar medicinals, photographic developers, intermediates, and other coal tar products increased however, reaching 1,933,370 pounds valued at $1,957,800 in 1934 against 1,808,575 pounds valued at $1,187,000 for 1933, it was stated.

● 1934 CHEMICAL ACTIVITY

The chemical industry abroad, as well as in the United States, was characterized during the year just ended, by the establishment of new plants, the conversion and extension of old plants, and the introduction of new chemical commodities, according to C. C. Concannon, Chief of the Commerce Department's Chemical Division.

Complete data are not yet available but it is believed Japan led all foreign countries in new developments and increased production. Germany was also active patricularly in the development of synthetic products to replace and reduce imports of natural materials, and in the conversion of old and idle plants to new uses, it was stated.

Several new chemical factories were erected in Canada, and in Mexico a fourth zinc oxide plant was completed and a lime oil factory was established.

In South America, Argentina, Brazil and Venezuela built several new chemical plants, and Chile commenced production of several medicinal and pharmaceutical products for the first time.

Practically every country in Europe built at least one new chemical plant during the year, Mr. Concannon stated. These European plants are either making products new to the country, or entirely new to the industrial world, such as lanoline made in Poland for the first time and "Parabernol" and a new synthetic substitute for natural shellac produced in Germany. Germany perhaps led all other European countries in the introduction of new chemical products, it is pointed out.

In Africa, where there are fewer changes, Kenya stood out prominently. The successful development of an essential oil industry in that colony brought "Kenya geranium oil" on the market in direct competition with the French product, and successful sample shipments of cedar-wood and peppermint were made. Exports of orange oil from Kenya to the United Kingdom were relatively large during the year. A new boiler compound called "Tannoda" was also made and marketed in Kenya.

Research during the year resulted in new uses for well known commodities, outstanding of which was the use of dry ice for air-cooling passenger planes in India.

● RAYON DYEING AND FINISHING MACHINERY

The Rodney Hunt Machine Company of Orange, Massachusetts, following its success in producing finishing equipment for handling rayon fabrics in recent years, announces that results have been so successful that they are led to enter the field more actively. For this purpose, they have engaged as consultant B. L. Hathorne, who will assist them in new designs and improvements of dyeing and finishing machines, especially for handling rayon and silk fabrics. Mr. Hathorne is well known to the readers of this journal through his activities as chairman of the Rayon Sub-committee of the A.A.T.C.C. and as the author of numerous articles which have been published herein. He is also the author of "Rayon Dyeing and Finishing".

The Rodney Hunt Machine Company advise that they are attacking the problem from the angle of providing machines that will be especially suited to the properties of rayon, because of feeling that rayons are sufficiently different from other yarns to warrant specially developed equipment. It is stated that the evolution of new machines, already under way, for dyeing and finishing rayon fabrics, cannot help but produce substantially better results, than can be produced on more conventional machines designed primarily for other industries.

The Rodney Hunt Machine Company, together with Mr. Hathorne and his entire staff state that they are at the service of firms interested in special equipment designed to produce the best possible results from rayon greige goods.

● WITH HARTFORD WOOLEN

Nelson A. Fisher has resigned his position as overseer of dyeing with La Porte Indiana Woolen Mills and has been placed in charge of dyeing with Hartford Woolen Mills, Hartford, Vermont.

● ONYX SALES CONVENTION

The Onyx Oil & Chemical Co., Jersey City, N. J., held another of its Annual Sales Conventions during the last week of 1934. Sales representatives from the Midwest, New England, Metropolitan, Southern and Canadian territories, joined with the executives, chemists and plant men of the Onyx company, in a week devoted to talks and discussions of processing and finishing methods and new laboratory developments. The week's activities terminated in a gala banquet at the Hotel Plaza, Jersey City, with eighty members in attendance. At the dinner, James H. Tully, vice president, officiated as toastmaster. Addresses were given by Victor H. Berman, president, Charles D. Ehrengart, secretary, Richard Von Oesen, general manager, Dr. H. H. Mosher, director of research, and several others of the organization.

● FUTURE MEETINGS, A.S.T.M.

1935 Regional Meeting—March 6—Philadelphia, Pa.

1935 Group Meeting of A.S.T.M. Committees—March 4 to 8 inclusive—Philadelphia.

Thirty-eighth Annual Meeting—June 24 through 28—Book-Cadillac Hotel, Detroit, Mich.

Exhibit of Testing Apparatus and Related Equipment—concurrent with the annual meeting.

The technical feature of the 1935 Regional Meeting will be a Symposium on Paint sponsored by Committee D-1 on Preservative Coatings for Structural Materials.

OPEN FORUM

Rules under which this department of the REPORTER is conducted are as follows:

1. Anyone who has a technical problem on which he would like advice may submit it to the Reporter and it will be published in the first available issue.

2. Any reader who feels that he has a solution of the problem may forward his reply to us and if we feel that the reply is suitable it will be published in a succeeding issue.

3. For each such reply published the Reporter will pay a minimum of $2.

4. In case there is more than one answer to the same question, the one covering the subject in the most complete and authentic manner will be published, or if two answers are sufficiently different both will be published. If two answers are considered equally good, the one first received will be given priority.

5. The Reporter will assume no responsibility whatsoever for the accuracy of the answers submitted—it is simply offering a vehicle for the public expression of its readers' opinions.

6. Both the questioner and answerer must send in his complete name and address. When requested we will publish only the initials or other identifying insignia.

New Questions

23—I understand that Phenol is used in the process of Flock Printing. If this is the case, I would be interested in knowing just how it is used, particularly as to the quantities involved and the conditions under which the operation is conducted.—**S. W. T.**

24—On numerous occasions, when a standing hydrogen peroxide bleach bath has not been used for four or five days, we have found that when adding peroxide to this bath or to fresh water in the same wooden tub, after running off the standing bath, immediately a violent hissing (the liberation of oxygen) takes place. Within an hour 25 pounds of 100 volume peroxide per 300 gallons of water has been used up.

The above happens in the presence or absence of silicate of soda or ammonia.

Once the above takes place it appears to be necessary to add sufficient peroxide to satisfy the "condition", after which the bath can be read, and made up to strength.

This abnormal condition is, of course, a waste of peroxide.

Have any readers any explanation as to the probable cause of the above taking place?—**T. F. A.**

25—Will you give what you consider the best method for bleaching worsted dress goods with Peroxide of Sodium and Peroxide of Hydrogen, showing formulae, with comparative costs, etc.—**D. G. H.**

Unanswered Questions

17—We are in need of mathematical text books on problems pertaining directly to textile printing but so far have been unable to find anything on the subject. If you know of texts or problems in math. especially adapted to this field, I would more than appreciate suggestions.—**O. E. M.**

20.—We have experienced partial color destroying action in basic color printing. The goods are folded face-to, and stored. The color destroying action is not uniform, showing bars, streaks, and blotches. When the material is baled this does not happen. Unfinished material does not show this result. No change in formulas over a period of years.—**G. O. Linberg.**

21—We are experiencing some difficulty in detecting and determining any amount of supposedly present compounds of Avirols, Gardinol and Neomerpin AS, in scouring, finishing, and delustering agents.

We have found some of these new products recommended for the above purposes to have present in them; chlorides, soda ash, and starches.

Please describe a method by which one can detect and if possible determine quantitatively their presence, in such as finishing, scouring and delustering agents.

I believe that this question may also be of some interest to many of our chemist readers.—**B. U.**

22—I should be pleased to have some of the readers of the Dyestuff Reporter furnish a list of dyes satisfactory for use in transparent lacquers which are reasonably fast to light and as nearly permanent as possible.

I have understood that water glass is sometimes used for fixing dyestuffs upon wood surfaces.

If anyone has had experience along the lines mentioned above I should be pleased to hear whether such a process is satisfactory or not. Also, whether it gives a clear transparent coating of sufficient depth to correspond with a lacquer.—**K. J. L.**

● GENERAL RELEASES

The General Dyestuff Corp. announces release of the following new products. Copies of circulars describing these products may be obtained on request.

Diazo Brown 3 R B A—a new developed brown manufactured by General Aniline Works which, when dyed in the usual way from a salt or Glauber's salt bath and diazotized and developed with Developer A, will produce full reddish brown shades. The use of Developer M T

or Developer Z A will produce yellower browns. The dyeings are said to be of good fastness to washing, fair fastness to cross-dyeing and moderate fastness to light. The dye is said to be of good solubility and level dyeing.

Algol Deep Black B D Paste—a vat color manufactured by General Aniline Works, which is recommended by the manufacturers for the printing of rayon fabrics. It is said to penetrate and level very well and to possess good fastness to light, chlorine and washing.

Chromoxane Brilliant Violet R E—a new chrome topped violet brought out by the I.G. which, when dyed from an acid bath and after-treated with bichromate, will produce bright reddish violets said to be of very good fastness to washing and milling, to water, salt-water and perspiration. The fastness to light is said to be fairly good. It may also be used on silk either top-chromed or on a chloride of chrome mordant.

Palatine Fast Dyestuffs on Unweighted and Weighted Silk—a sample card illustrating 29 brands and numerous compound shades on piece goods. There are also detailed fastness tables of various products.

TECHNICAL NOTES

(Continued from page 28)

Dyestuffs and Intermediates (Anthraquinone Series)

German Patent No. 478,739 (3/VII/'29 — *British Dyestuff Corp., Ltd.* — By heating 1-4-dialkylamino-anthraquinones with sulfuric acid of various strengths (from common concentrated to fuming of considerable percentage) at about 150°-220° C., products are formed which were formerly assumed to be hydroxyl-amino derivatives of anthraquinone (one alkyl group from a dialkyl-amino group being thought to be replaced by a hydroxy). The present process treats the dialkyl-amino compounds with fuming sulfuric acid of high percentage, in the presence or absence of boric acid, at about 180°-220° C. It has been found that the former interpretation of the reaction is incorrect; what really takes place is only a dealkylation, one of the alkyl groups in each dialkyl-amino group being replaced by hydroxyl—the products, i.e., are (monoalkyl-hydroxy-)amino derivatives.

One example is given—the product described dyes acetate silk a light bluish violet.

Vat Dyestuffs (Yellow) for Wool

German Patent No. 470,503 (18/I/'29) (*addition to G. P. No.* 469,135 of 1/I/'27)—*I. G. Farben-Ind. A.-G.*—A slight development of the process cited in the original patent (fusion of 1-hydroxy-anthraquinone with caustic alkali). In this case, the products are after-treated with an oxidizing agent to carry further their purification. If the process of purification by oxidizing agents, and the separation of them from solution, from their leuco-form, are combined in one operation (i.e., of course, in sequence or parallel in the same solution) the yield is improved. The process may be carried out most simply by treating the solution of the melt in water with a suitable oxidizing agent, the impurities being destroyed and the leuco-compound being oxidized concomitantly, rather, perhaps, than successively.

Three examples are given. The products dye wool a pure yellow.

Vat Dyestuffs (Anthraquinone Series)

German Patent No. 470,550 (16/V/'29)—*I. G. Farben-Ind. A.-G.*—The principal patent involved the use of anhydrous aluminum chloride alone as condensing agent for the intermediates specified (1-amino-anthraquinones). The present modification still employs aluminum chloride, but in the presence of organic bases (amines) (with or without the presence of water!). In this way products are obtained which have as yet not been gotten by using caustic alkali or aluminum chloride alone, or in mixture with inorganic salts. The reaction seems to proceed in more than one direction, depending upon which amine is used, and whether or not water is also present.

Four examples are given.

CLASSIFIED

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

POSITION WANTED—Dyestuff Salesman well known in the southern territory, has following in Dyeing and Printing, thorough knowledge of the application of color. Age 38 years. Would consider mill connection, eight years selling Dyestuffs and Chemicals, seven years practical mill experience. Best of references. Address Box No. 847, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED—Dyer age 30, married, ten years experience dyeing cotton skeins and sewing thread with direct, basic, developed, vat and napthol colors. Write Box No. 848, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.